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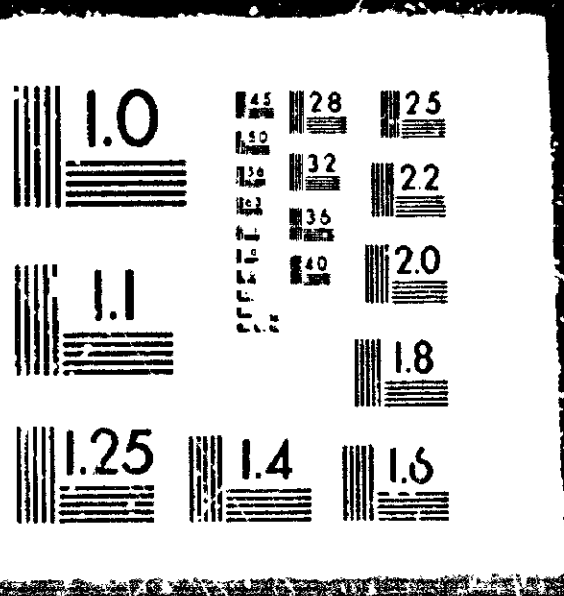

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Special Investigation Report
Air Traffic Control System

(U.S.) National Transportation Safety Board
Washington, DC

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U.S. Department of Commerce
National Technical Information Service
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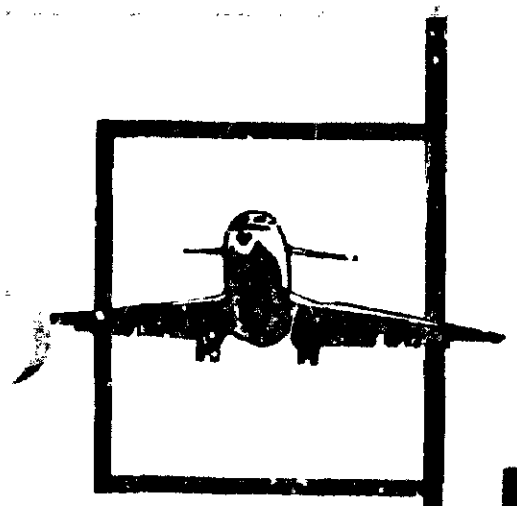

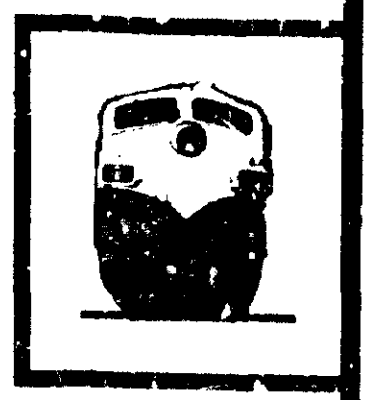

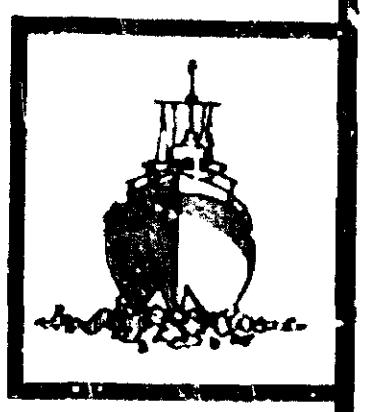

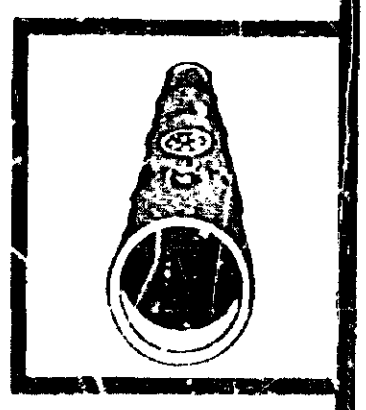

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION REPORT

AIR TRAFFIC CONTROL SYSTEM

NTSB-SIR-81-7

UNITED STATES GOVERNMENT

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16. Abstract This National Transportation Safety Board special investigation of the air traffic control system in the United States followed a strike, on August 3, 1981, of the Professional Air Traffic Controllers Organization (PATCO) against the Federal Aviation Administration (FAA) which resulted in the walkout of about 11,400 of the 17,275 controller workforce. The strike left the air traffic control (ATC) system with a significantly reduced air traffic capacity which ranged from 75 percent to 83 percent of the prestrike scheduled commercial air carrier levels.

The special investigation was conducted in August and September 1981. Forty-five ATC facilities were surveyed and about 220 controllers and supervisors were interviewed. Industry and government officials were questioned on ATC procedures and flight operations in the poststrike ATC system. The investigation included an analysis of ATC data, the ability of the FAA to meet staffing requirements, the qualifications of the controller workforce, training for new controllers, the effect of stress and fatigue, facility supervision and management, the control of the capacity of the system, and computer and equipment reliability.

The Safety Board concluded that no basic ATC procedures were changed or compromised in order to keep the ATC system in operation, and that the high level of ATC safety required is possible within the present system and will be possible as the system is rebuilt. The Safety Board made a number of safety recommendations to the FAA designed to enhance ATC system safety.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION

Adopted: December 8, 1981

AIR TRAFFIC CONTROL SYSTEM

INTRODUCTION

The National Transportation Safety Board was established by the Department of Transportation Act of 1966, which established the Department of Transportation. Among its duties, the Safety Board was charged with the responsibility of investigating transportation accidents, a responsibility that elements of the Safety Board had previously performed as a bureau under the Civil Aeronautics Board.

The Independent Safety Board Act of 1974 established the Safety Board as an entirely independent Federal agency and broadened the responsibilities of the Board in the investigation and prevention of transportation accidents.

The Safety Board is charged, in part, with:

- Investigating certain aviation, highway, railroad, pipeline, and marine accidents.
- Reporting publicly on the facts, conditions, and circumstances and the cause or probable cause of such accidents.
- Issuing periodic reports to the Congress and to Federal, State, and local transportation safety agencies and recommending measures to reduce the likelihood of transportation accidents.
- Initiating and conducting special transportation safety studies and investigations.

On August 3, 1981, the Professional Air Traffic Controllers Organization (PATCO) declared a strike against the Federal Aviation Administration (FAA). The strike resulted in the walkout of about 13,000 controllers. Although some of the strikers returned, about 11,400 controllers did not return and were subsequently dismissed. The actions by PATCO and the FAA response left the air traffic control (ATC) system with a significantly reduced air traffic capacity. According to the FAA, the initial poststrike ATC system was initially managed by about 4,669 nonstriking controllers, 3,291 team supervisors and control and management staff, 800 military controllers on detail, and about 1,000 newly hired personnel.

The Safety Board's significant background and knowledge of the ATC system, gained through its accident investigation work, the observations of its investigators during flight in airliner cockpits, and extensive discussions with industry representatives and within the FAA, served as the basis for the Safety Board's initial informal monitoring of the ATC system operation during the first days of the strike. Although the Safety Board's initial observations did not indicate any unsafe conditions in the ATC system, the Safety Board felt it needed to examine formally the actual operation of the system. Moreover, it was receiving questions from Congress, the media, and the public about the safety of air

transportation with the curtailed ATC system. Allegations concerning unsafe procedures, unqualified controller personnel, and other safety issues had created significant public doubts about the safety of the ATC system. Therefore, on August 13, 1981, the Safety Board voted unanimously to begin a special investigation of the ATC system.

The purpose of the special investigation was to assemble sufficient data to enable the Safety Board to analyze the operation of the ATC system and to evaluate the safety of the system. Although some comparisons to prestrike operation would be necessary, the Safety Board was interested primarily in evaluating the ATC system against fundamental safety and air traffic control considerations and procedures.

The Safety Board identified several short- and long-range safety issues for consideration during the investigation. Short-range issues included the ability of the FAA to meet staffing requirements, the qualifications of the reduced controller workforce to operate the ATC system safely, the use of military controllers, the transfer of controllers who had been working at less active facilities to more active facilities, the conduct of classroom and facility training programs, the effect of stress and fatigue on the controller workforce, the ability of the ATC system to balance air traffic capacity against controller staff and qualification levels, the adequacy of facility management, and the FAA's quality control measures for the system, individual facilities, and individual controllers. Long-range issues were the recruitment and training of replacement controllers, constraints to match system growth to increases in the controller workforce, and the maintenance of a high level of safety until the ATC system is once again operating normally.

The special investigation considered the operation of the ATC system during the period from August 3, 1981, through October 9, 1981. The special investigation team consisted of 16 Safety Board investigators. The investigation covered these five broad areas:

1. ATC system management. A group evaluated the operation of national air traffic flow control procedures, the ability of the ATC system to expand, management changes, procedural changes, overall efficiency and capacity of the system, internal FAA procedures to evaluate safety, controls on the system traffic capacity, and statistical information.

2. Aviation industry survey. On August 31, 1981, a questionnaire requesting information on the operation of the ATC system was mailed to 89 organizations. Additionally, hundreds of questionnaires were distributed to general aviation pilots. Investigators also interviewed personnel at fixed-base operations and flight schools, airline managers, and other qualified individuals. The responses from these groups provided the Safety Board with data on the attitudes of pilots toward the system, the levels of demonstrated controller proficiency, and the measures taken by various airlines and organizations to insure that the safety of flight operations was not affected adversely by the strike.

3. Controller stress and workload survey. The FAA methods to detect and control the effects on controllers of stress and fatigue which might result from the new working conditions were evaluated. The investigation included actual observations of the working conditions and the significance of fatigue, stress, and workload on controllers.

4. Controller training and use. A group examined the FAA training curriculum for new controllers, the standards of performance for new

controllers, projections for bringing the controller workforce up to acceptable levels, and the facility training programs. The group also studied the training and use of the military controllers who had been temporarily detailed to ATC duties.

5. ATC field survey. The field team visited 45 facilities to obtain data, conduct interviews, and observe ATC procedures. Additionally, Flight Service Stations and General Aviation District Offices were visited. More than 220 controllers and supervisors were interviewed during this phase of the investigation. The purpose of the field survey was to gather objective information on the current ATC system, through a standardized method of data collection and through controlled interviews, and to identify existing or potential safety problems.

BACKGROUND

Structure of the Air Traffic Control System

The FAA operates the ATC system through a network of 449 facilities. The facilities range from VFR (visual flight rules) towers to terminal radar approach control facilities (TRACON) to air route traffic control centers (ARTCC). (See appendix A.) Each facility controls aircraft in different phases of flight. VFR towers generally are found at smaller airports which do not have radar approach control capability. Controllers in VFR towers provide radio communications to aircraft landing and taking off at the airport. Their airspace extends up to 5 miles from the airport. Nearby ARTCC's or TRACON's at larger airports provide radar coverage for aircraft operating at airports with a VFR tower. Controllers at VFR towers coordinate with controllers at TRACON's and ARTCC's to provide IFR (instrument flight rules) services to aircraft operating to and from a VFR tower.

A major airport will have a TRACON located with the control tower. The TRACON will provide approach and departure control radar services to aircraft operating at the major airport and to nearby airports which do not have a radar capability. The complexity of the ATC activities around major airports results in controllers in TRACON's providing air traffic service to virtually all aircraft operating in the airspace of the TRACON at lower altitudes. Controllers in a TRACON manage air traffic from the time the aircraft is transferred from tower control until it enters the ARTCC airspace.

There are 20 major ARTCC's in the National Airspace System (25 ARTCC's total). The primary purpose of the ARTCC is ATC service to aircraft in the en route phase of flight. Although the ARTCC does provide approach control service to some airports, the ARTCC normally controls aircraft which are flying at higher altitudes.

Controllers in ARTCC's work at one or more sectors, each of which encompasses specific geographical airspace portrayed on a radarscope. Controllers in towers and radar controllers at TRACON's and VFR towers work at control positions, which include positions in the tower cab and radar positions in the radar facilities.

Professional Air Traffic Controllers Organization

PATCO was organized in January 1968 to represent air traffic controllers in labor negotiations with the FAA. The relations between the FAA and PATCO were frequently troubled by labor problems during the ensuing years. The issues which divided the two organizations were pay, working conditions, equipment, and facility staffing levels. The

conflicts resulted in nationwide air traffic slowdowns and "sickouts" on different occasions in the late 1960's and the 1970's.

Negotiations for a new contract between the FAA and PATCO began in February 1981, and PATCO presented 99 points which it wanted in the new contract. The major PATCO bargaining points were:

1. A "survivable" career--PATCO contended that too many controllers are forced to retire before they reach retirement age due to the pressures and work conditions with which the air traffic controller must contend.

2. Wages--PATCO requested, in part, a $10,000 across-the-board annual increase in pay for each controller, a twice-a-year cost of living increase which would equal 1 1/2 times the inflation rate, and increases in night and holiday differential and training pay.

3. Workweek--Reduction from a standard government 40-hour week to a 32-hour week.

4. Retirement--Retirement after 20 years as a controller at 75 percent of the base salary regardless of age. The current law allows a controller to retire on 50 percent of base pay after reaching age 50 with 20 years of controller service, or at any age after 25 years of controller service.

A strike deadline of June 22, 1981, was set by PATCO. However, just before the deadline, the PATCO negotiating team accepted an offer by the FAA which amounted to a yearly increase of $40 million in pay and benefits--well short of the original PATCO demand. An immediate strike was averted and the controllers continued to work. However, when the new contract was presented to the membership for a vote, it was rejected by 95 percent of the PATCO members. New negotiations began on July 31, 1981. PATCO reduced the union demands to a pay and benefits package which was estimated at $500 million by PATCO and at $680 million by the FAA. The negotiations ended when the sides could not reach an agreement, and on August 3, 1981, about 13,000 PATCO controllers initially went on strike. Ultimately, about 11,400 controllers did not return to work.

Federal Aviation Administration Planning

In January 1980, the FAA began the development of the National Air Traffic Control Contingency Plan. The plan, which anticipated a controller strike or job action in 1981, was "to insure the FAA's ability to provide a safe and orderly operation of the air traffic control system with the available, qualified manpower. The basic objective of the plan is to maximize the number of aircraft that can be accommodated with the reduced workforce." The contingency plan was coordinated with the Department of Defense and the airline industry and on November 13, 1980, it was published in the Federal Register.

The contingency plan was based on a worst-case assumption that all PATCO controllers would strike and that only 15 percent of the total ATC workforce would be available to control traffic. Because this manpower level would severely restrict the ATC system's capacity, detailed plans were developed which addressed system operation, coordination and reporting procedures, schedule and flight approval requirements, potential restrictions on various flights, preferential routes and altitudes, and priorities. Four priorities were developed. Priority No. 1 was military flights that were necessary to national defense, critical military activities, or emergency medical flights. Priorities

Nos. 2 and 3 caused fixed daily airline schedules and insured a safe flow of air traffic throughout the system. Priority No. 4 was all other flights not covered by Priorities Nos. 1 through 3.

On March 13, 1981, the FAA adopted 14 CFR 91.100, Emergency Air Traffic Rules. This regulation empowered the FAA Administrator to issue immediate air traffic rules or regulations by the issuance of a Notice to Airman (NOTAM). Title 14 CFR 91.100 became the basic authority of the FAA to enforce all national or local procedures which might be required by the contingency plan or any other modified plan which was necessary to operate the ATC system.

To increase the number of qualified controllers who might be available in the event of a strike, ATC facility management began programs in early 1981 to insure that supervisory and staff personnel maintained qualifications on control positions. Additionally, many facilities studied methods to combine sectors in order to reduce controller requirements. Some facilities actually had combined sectors and had developed a reduced staff plan before August 1981. For example, the Atlanta ARTCC combined its 39 existing sectors into 28, while Indianapolis International TRACON combined some of the operating positions in that facility. Planning of this nature was common at most facilities.

The FAA had made many estimates, based on surveys by facility managers and on information from sources inside PATCO, of the number of controllers that could be expected to remain working if a strike occurred. As the strike deadline of June 22, 1981, approached, the FAA concluded that fewer controllers than anticipated would leave their jobs, and that more than 15 percent of the workforce would be available to operate the system. The FAA recognized that it might be possible to accept and safely control more air traffic by using "flow control" procedures and less restrictive airline scheduling constraints than if the full contingency plan were implemented. As a result, a second plan, the Air Traffic Control Interim Operating Plan, was developed to be used in the event of a strike.

The plan involved fewer restrictions on scheduled operations, provided greater system flexibility and assumed a higher system capacity than the original contingency plan. It was developed in the Central Flow Control Facility, an office of the Air Traffic Control Command Center (ATCCC). The facility employed the ATCCC's computer system in Jacksonville, Florida, to develop simulated computer programs based on specific air traffic capacity at 23 major airports. The programs were refined until scheduled traffic was adjusted to a level which could be managed by flow control programs. As a result of the coordinated efforts of the ATCCC, a modulated air traffic flow plan was developed and monitored by Central Flow Control Facility specialists. The primary objective of the program was to prevent saturation of terminal airspace and eliminate arrival delays when the traffic demand for a particular airport exceeded the programmed hourly acceptance rate of the facility. If that situation was likely to occur based on forecast traffic, Central Flow Control Facility specialists would impose ground delays on departure for flights scheduled into the particular airport.

After the Strike

Special Federal Air Regulation (SFAR) 44, Air Traffic Control Interim Operations Plan was adopted on August 3, 1981, to authorize the Administrator to establish procedures for the operations of the National Air Traffic Control System. It included specific authority to reduce air traffic schedules at 23 major airports. The new plan, which was called the "75-50 Plan," was placed into effect as the PATCO strike began on August 3, 1981. The "75" represented the percentage of scheduled commercial airline operations that the plan sought to maintain while "50" was the percentage of operations at

the 23 major airports. SFAR 44 also incorporated a prohibition effective on August 3, 1981, of any IFR operation by aircraft with a gross takeoff weight of 12,500 pounds or less. Scheduled air taxi operations were excluded from this requirement. The 12,500-pound restriction was rescinded on August 17, 1981, and has not been imposed since.

SFAR 44-1 superseded SFAR 44 on September 9, 1981. The important change promulgated by SFAR 44-1 was a new procedure to reduce traffic at 22 major airports (one of the original 23 airports was dropped). The basis for the reduction of flights at the 22 airports was shifted to a tailored hourly percentage of the airport's prestrike operations rather than the arbitrary 50-percent uniform reduction. This procedure was further modified by SFAR 44-2 on September 29, 1981. SFAR 44-2 replaced the tailored hourly percentage scheme at the 22 airports with a system which was based on airline flight schedules in the Official Airline Guide.

Although the methods for limiting the system capacity were refined successively by SFAR 44, 44-1, and 44-2, the principle did not change. In fact, no major capacity-limiting measure was changed until October 1981. By early October the percentage of scheduled commercial flights had increased from the original 75 percent to about 83 percent. General aviation and other non-scheduled IFR traffic increased in September. The increasing departure delays and observations by controllers that the traffic workload was becoming significantly heavier led to an October 6 announcement of a planned reduction of commercial flights back to 78 percent by December 1, 1981. Additionally, a General Aviation Reservation Program was announced to place restrictions on the number of IFR general aviation flights in the ATC system. However, aside from the lack of controls to deal with the traffic increases in the system in September, the FAA's preparation for the operation of the ATC system proved to be operationally feasible during the immediate poststrike period.

Of the 17,275 prestrike controller workforce, 13,311 were full performance level (FPL) controllers 1/ and 2,939 were developmental controllers. 2/ (See table 1.) The loss of 11,400 PATCO controllers reduced the number of controllers available to 4,669 "operational controllers" on August 3. The term "operational controller" includes a developmental controller who is qualified on only two control positions or sectors, rather than six or seven sectors or positions on which a full performance level controller normally would be qualified. If one assumes that half the prestrike developmental controllers were qualified as operational controllers, the effect of the strike actually was to reduce the nucleus of the operational controller workforce from about 14,800 to 4,669, a reduction of more than 68 percent. By September 30, the number of operational controllers had increased slightly to about 37 percent of the prestrike level of controllers.

To supplement the operational controllers, every controller, supervisor, and facility staff person who could requalify was brought back to work at control positions. All of the team supervisors had maintained certification on sectors and positions. A review of facility training and medical records revealed that some staff and supervisory personnel were requalified in late July and early August, which added 1,092 persons to the

1/ A full performance level controller is a controller at an ARTCC who is qualified at all the sectors in an area of specialization. The equivalent of a full performance level controller in a terminal facility is a facility-rated controller.
2/ A developmental controller is not qualified on all sectors within an area of specialization at an ARTCC or at all control positions in a terminal facility. However, a developmental controller may be certified and proficient at some or most of the sectors or positions.

Table 1.—Controller staff levels.

Position title 1/	Staff Level			Temporarily assigned as of
	July 31	August 31	September 27	September 27
Trainee	125	112	93	0
Developmental	2,939	1,382	1.626	89
Journeyman (FPL)	13,311	4,669 2/	4,872 2/	521 2/
Team supervisor	2,118	2,143	2,171	251
Controller staff 3/	900	726	635	53
Management staff 4/	1,647	1,570	1,541	205
Subtotal	21,040	10,602	10,938	1,119
Military		800	715	
Total		11,402	11,653	
Available control staff	13,311 5/	7,960 6/	8,131 6/	

1/ See appendix B for title descriptions.
2/ Includes journeyman (FPL) controllers and developmental controllers checked out on two or more sectors.
3/ Includes data systems specialists, military liaison security specialists, area specialists, and plans and procedures specialists.
4/ Includes assistant chiefs, deputy chiefs, chiefs, operations officers, evaluation and proficiency development officers, evaluation and proficiency development specialists, data systems officers, en route automation supervisors, military liaison officers, air traffic representatives, area officers, and plans and procedures officers.
5/ Includes journeyman (FPL) controllers only.
6/ Includes all operational controllers, all team supervisors, and one-half of both the controller staff and the facility management staff.

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poststrike controller workforce. (See table 2.) On a regional basis, retired FAA controllers were contacted and asked to come back to work on a reemployed annuitant basis. By August 31, 147 reemployed annuitants had returned and 54 were requalified to work traffic. The remainder served in training, staff, and administrative functions. The criteria for a reemployed annuitant to work as a controller was that the person not have been separated from the FAA for more than 3 years, that the person meet the requirements of a Class II medical examination, and that the proper training and recertification be completed.

A major source of controller assistance was provided by the Department of Defense (DOD). Although the DOD and the FAA had coordinated plans by which military controllers were to be provided, no final planning took place until June 2, 1981. In the initial planning discussions, a figure of 400 controllers was discussed, but the FAA indicated that the support would not be long-term. On August 2, the FAA requested the DOD to send 100 controllers to New York ARTCC, and to airports in New York, Chicago, and Atlanta. Six additional increments were requested during August with about 810 DOD controllers ultimately being assigned to the FAA. Military controllers underwent facility training at the new duty assignment and performed some non-ATC duties in the facilities. By mid-September, many had checked out on flight data, clearance delivery, and local and ground control positions. Some military controllers qualified at radar positions at a limited number of facilities. The FAA plans to release military controllers as soon as new controllers are trained. However, military controllers will probably be used in the ATC system through 1982.

Table 2.—Employees controlling traffic between August 3, 1981, and September 4, 1981, who were not actively doing so prior to strike.

Position title 1/	Tower	Centers	Total
Chief	129	0	129
Deputy Chief	25	1	26
Operations Officer	16	0	16
Operations Specialist	6	1	7
Evaluation & Proficiency Development Officer	4	3	7
Evaluation & Proficiency Development Specialist	131	155	286
Data Systems Officer	7	2	9
Data System Specialist	137	92	229
Assistant Chief	59	15	74
Area Specialist	0	66	66
Air Traffic Representative	3	0	3
Military Liaison Security Specialist	0	34	34
Flow Controller	5	27	32
Plans & Procedures Specialist	46	1	47
Team Supervisors	23	4	27
Developmental	2	3	5
Journeyman (FPL)	35	19	54
Miscellaneous	32	9	41
Total	660	432	1,092

1/ See appendix B.

Another source of staffing came from 70 less active towers that the FAA closed temporarily after August 3. The hours of operation at another 250 airports were reduced. No Flight Service Stations were closed.

The workweek of the controller workforce was established at 60 hours per week initially. This figure was reduced as procedures were refined and as new personnel arrived at facilities. By September 6, 70 percent of the controllers were scheduled for a 48-hour week with the remainder scheduled for a 40-hour week. This schedule continued throughout September and, according to the FAA, will continue in 1981. Despite the publicly announced "scheduled" 48-hour workweek, the Safety Board found many instances where additional overtime was worked by controllers. Traffic loads, weather problems, shift change coverage, or other factors were responsible for the additional hours. As a result, scheduled workweeks of 6 days, 8 hours a day, were frequently lengthened by 2 to 4 hours. The Administrator of the FAA voiced the concern over the effects of fatigue and stress caused by the long work hours, and stated that no employee would be scheduled for more than 48 hours per week or consecutive 10-hour days after September 6. However, many controllers continued to work beyond these limits as a result of unscheduled overtime, which was often performed voluntarily.

INVESTIGATION

The operation of the ATC system without the 11,400 controllers who went on strike resulted in many questions concerning the safety of the ATC system, and the effectiveness of the procedures adopted after the strike to control aircraft. The Safety Board examined the ATC system in depth during August, September, and part of October 1981. During this period, the programs developed to accommodate a large reduction in controllers were refined, and the capacity of the ATC system was reduced to match the controller workforce level.

During the investigation, the Safety Board determined that no air traffic regulations or FAA requirements which governed the control of aircraft were altered to the extent that the level of air safety was reduced. No ATC safety procedures were changed or compromised in order to keep the ATC system in operation. These conclusions were based on extensive observation of operations in ATC facilities and in airliner cockpits by Safety Board investigators; through a continuous review of the application of ATC procedures, orders, and regulations; and by an examination of the qualifications of the controllers and supervisors who operated the ATC system.

The investigation, coupled with the decrease in the numbers of operational errors, 3/operational deviations, 4/ and near midair collisions, 5/ that were reported during the period of the investigation, led the Safety Board to conclude that the ATC system was operated safely in the months after the strike. Furthermore, the Safety Board concluded that the FAA is capable of operating a reduced ATC system safely during the reconstruction of the system providing certain important actions are taken. First, the total traffic volume of the system, both IFR and VFR, must continue to be limited to that which can be handled safely by the reduced controller workforce available to manage the traffic. This requirement includes the management of general aviation aircraft in a fashion that does not create a conflict between IFR and VFR operations. Second, the FAA training program must maintain high entrance standards, and must produce air traffic controllers equally skilled and competent as those being replaced. Finally, the continued safe operation of the ATC system can only be assured by the continued combined efforts of not only the FAA ATC management and controllers, but also the pilots, airline management, and aviation organizations who establish flight operations standards. Pilots have a shared responsibility for air safety with the controllers even in normal operations, and both must be aware of the limits of the ATC system during the reconstruction.

Data Analysis

Immediately after the strike began on August 3, 1981, allegations began to be made about unsafe conditions in the ATC system. Reports of operational errors, operational deviations, and near midair collisions by PATCO and other groups created a widespread sense of uncertainty. To determine if the claims of safety hazards were representative of

3/ Operational Error. An occurrence which results in less than the applicable separation minima between two or more aircraft, or between an aircraft and terrain or obstacles and obstructions as required by FAA Handbook 7110.65 and supplemental instructions. Obstacles include vehicles/equipment/personnel on runways.

4/ Operational Deviation. An occurrence where applicable separation minima was maintained, but when less than the applicable separation minima existed between an aircraft and protected airspace, or when an aircraft penetrated airspace or an airport movement area that had been delegated to another position of operation or facility without prior approval.

5/ Near Midair Collisions. Instances when a report is received by ATC personnel from an aircrew member stating that a collision hazard existed between two or more aircraft. actual ATC conditions, the Safety Board obtained information from the four source

organizations which collect ATC data: FAA, PATCO, the Air Line Pilots Association (ALPA), and the Aviation Safety Institute (ASI). 6/ Similar data for September were not available except as noted in the report. Records from the National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System (ASRS) 7/ also were obtained but were analyzed independently because ASRS reports do not contain information which links any reported incident to other reports by date or by operator.

In general, little correlation was found among the data from the four source organizations. The lack of uniformity in definitions used by the four organizations and the different methods of data-gathering, may account for the lack of correlation. The correlation of information was performed manually by establishing a matrix which grouped events in rows according to date and type. The data analysis covered August 3-31, 1981. During that time, PATCO reported 58 operational errors, ASI reported 41, ALPA reported 30, and the FAA reported 24. A further breakdown of these data showed that 72 percent of PATCO's reported errors, 63 percent of ASI's reported errors, 100 percent of ALPA's reported errors, and 58 percent of the FAA's reported errors occurred within the first 2 weeks of the period. Of the 58 operational errors reported by PATCO, 7 were also reported by ASI, 15 by ALPA, and 1 by the FAA. Of the FAA's 24 reported operational errors, 1 corresponded to a PATCO report, 3 corresponded to ASI reports, and none to ALPA reports. (See table 3.)

Table 3.—Comparison of operational error data.

Source of information	Operational errors August 1981	Errors per million operations	Percentage change from August 1980 1/
Federal Aviation Administration (FAA)	10	3.76	-66
Aviation Safety Institute (ASI)	26	9.76	-12
Air Line Pilots Association (ALPA)	22	8.26	-25
Professional Air Traffic Controllers Organization (PATCO)	43	16.14	+46
Errors reported by ASI, ALPA, PATCO, or FAA (duplicate reports of same error only counted once)	78	29.28	+164
Errors reported by FAA plus any errors reported by at least two sources	26	9.76	-12

1/ Based on August 1980 data from FAA.

6/ A nonprofit aviation safety organization which operates an aviation hazard reporting system.

7/ An aviation hazard reporting system which is administered by NASA. The person filing a report is not required to include a name or address on the report. NASA analyzes the reports and forwards information to the FAA.

Reports of near midair collisions from the four source organizations also could not be correlated. During the reporting period, ASI reported 40 near midair collisions, ALPA reported 16, PATCO reported 31, and the FAA reported 28 unconfirmed near midair collisions. However, each of these counts was lower than the 60 unconfirmed near midair collisions reported to the FAA in August 1980. Seventy-three percent of the unconfirmed near midair collisions occurred during the first 2 weeks of the strike.

Judgments about the ATC system performance based on reports from any one organization are of questionable statistical value because of the lack of correlation among the reports from all sources. However, the fact that 73 percent of the reported operational errors and near midair collisions occurred within the first 2 weeks of the strike suggests there was some relationship between the errors and the reconstituted controller workforce. Furthermore, only 9 of the 28 near midair collisions reported by the FAA were recorded by the other three organizations. This fact indicates an apparent lack of reporting effectiveness in the PATCO, ASI, and ALPA systems; a reluctance of persons to file official near midair collision reports with the FAA; or differences in definition by the organizations.

The ASRS reports received during August and September 1981 were compared to reports over a similar period in 1980. (See table 4.) The reports for each year include near midair collision and deficiency reports which were received in the subject months. However, the reports do not necessarily reflect events that occurred in these months, since the monthly count is based on when the report is received.

Table 4.-- ASRS data.

	August		September	
	1980	1981	1980	1981
ASRS system deficiency reports submitted to ASRS by:				
Controller	307	28	280	9
Pilot	230	99	163	69
Other	36	8	28	1
Total	573	135	471	79
Near midair collision reports submitted to ASRS	45	14	44	24

Neither the Safety Board nor a spokesman for the ASRS was able to establish why there was a significant decrease in reported near midair collisions and deficiencies during the 1981 reporting period. One reason could be the decrease in the amount of flying done because of the strike. It is also likely that all the reports were not received by NASA by early October.

The Safety Board could not explain the sharp change in the ratio of pilot-submitted deficiency reports to controller-submitted deficiency reports. Historically, controller reports have outnumbered pilot reports 48 percent to 46 percent. In August-September 1980, controllers submitted about 56 percent of the deficiency reports while pilots submitted about 38 percent. During August-September 1981, controller reports were only 15 percent of the total number of deficiency reports while pilot reports increased to 81 percent.

Several reasons were offered for the significant percentage change. Working controllers stated generally that the deficiencies were not occurring. A few stated that they were too busy for paperwork. When a problem developed, it was resolved on the spot

without the submission of ASRS reports or an FAA unsatisfactory condition report, according to some controllers. These same controllers stated, however, that all operational errors and operational deviations were reported. An ASRS staff member stated that many of the working controller force either did not know about the ASRS system or that they were not the element of the controller workforce that routinely submitted ASRS reports.

The FAA reported the following operational error information for August and September 1981:

	August		September	
Operational errors	1980	1981	1980	1981
Terminal area	26	17	26	15
Centers	28	7	26	6
Total	54	24	52	21

These data represented a 1981 average of 0.77 operational errors per day, compared to an average of 1.83 operational errors per day in 1980. The operational error rate for 20 major ARTCC's and 22 major airports was 3.89 per million operations for August-September 1981. The rate for the same period in 1980 was 10.46 per million operations. Operational deviations decreased from a daily average in 1980 of 1.72 to 0.35 in 1981. A total of 54 controllers were involved in the 45 operational errors in August and September 1981. They included 2 assistant chiefs, 15 team supervisors, and 37 operational controllers.

The Safety Board found no evidence that working controllers were urged not to report operational errors or operational deviations. In fact, there was significant emphasis by FAA management at all levels on reporting these deficiencies as required. The Safety Board believes that two significant reasons accounted for the reduction in the operational error rate. The most obvious reason was the reduction in IFR flying by as much as 20 to 30 percent at many facilities. The second reason was the increased separation distances between aircraft that were used in the poststrike ATC system. These conclusions were generally concurred in by a few striking PATCO controllers, and by the working controllers, FAA facility management, and airline pilots.

However, many striking controllers alleged that operational errors were not being reported by the FAA because controllers did not want to make the system look bad or because supervisors discouraged such reports. The enthusiasm and positive attitude displayed by the controller workforce after the strike could have provided the reason for a controller to overlook an operational error or an operational deviation and thus have caused the reduction in the reported operational error rate. To determine if operational errors were not being reported, Safety Board investigators recalled ATC tapes at several facilities for aircraft which had activated conflict alerts. The aircraft positions were plotted to determine if an operational error existed. None was found. The Safety Board believes that the depth and scope of the facility investigation would have uncovered indications of a possible coverup effort if one existed.

The overall analysis of the data relating to the ATC system indicates that the system was operated safely in August and September 1981. Although the majority of the data did come from government agencies, the operational error data of ASI and ALPA, plus the near midair collision data of all agencies, showed a general decrease in hazard reports compared to prestrike periods.

Controller Training And Use

The PATCO strike resulted in the reduction of full performance level controllers from 13,311 on July 31 to 4,669 operational controllers on August 31. Even taking into consideration the fact that the FAA announced that the prestrike controller workforce included about 3,000 controllers that were not essential to operate the system, so that only 7,400 controllers need to be replaced to bring the workforce to 14,000 full performance level and developmental operational controllers, the task will be a major one. The FAA staffing projections establish January 1, 1984, as the target date to reach the new full strength level. (See table 5.)

The Safety Board examined several major issues in the training and use of controllers, including the staffing, curriculum, and standards for the training program at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma, and at individual ATC facilities. The Safety Board examined the projections of when the center training programs could provide new controllers to field facilities, and the training problems that might be caused by the large number of new controllers in the facilities. Finally, programs for the use and training of controllers without center training and of military controllers were examined to determine if standards of proficiency and safety were being compromised.

The initial training for newly hired controllers is conducted by the FAA at the Mike Monroney Aeronautical Center. The major courses of instruction are the terminal and en route specialties which train controllers for employment in towers and TRACON's or in ARTCC's, respectively. Students are recruited for particular vacancies and are assigned to a specialty before arriving at the center and subsequently return to the preselected facility. The assignment of the training specialty is made by the FAA region which selected the applicant from the Civil Service register.

The center actually conducts about 20 percent of the total student training, with the remainder given at the assigned facility. The courses of instruction for the terminal and en route specialties are divided so that a logical progression of skills can be developed as the student moves from the training center to the facility.

The terminal specialty training is conducted in 11 phases. Phases 1 through 5 are conducted at the center and require 20 weeks 3 days. The student completes Phases 6 through 11 at the assigned facility. The investigation determined that the prestrike training curriculum and requirements were not being compromised in an effort to train more controllers. The only change in the terminal specialty training was a sequential order of phase completion. As of October 1981, Phase 5, Radar Air Traffic Control, will not be administered during the initial assignment at the training center. In the past, the student completed radar training in Phase 5 but did not work radar in the facility until Phase 11 was started. If the facility did not have a radar capability, there was no requirement to work radar and Phase 5 training would have been wasted. Consequently, after October 1981, students will return to the center to complete Phase 5 when the student is ready to begin facility radar training.

The decision to delay center-administered radar air traffic control training until the developmental controller starts radar qualification at a facility is logical. Radar qualification is the last training phase and normally did not occur until 1 year or more after the developmental controller had completed radar training at the center. The sequential change places the developmental controller in the facility 6 weeks earlier and allows the person to work in the ATC system at nonradar positions. In addition, exposure to operational practices and procedures supporting radar traffic control is expected to enhance the developmental controller's ability to pass the radar air traffic control training phase upon return to the training center for formal radar training.

Table 5.--FAA center/terminal staff projections.

Position Title	July 31, 1981	Sept. 27, 1981	Jan. 1, 1982	Jan. 1, 1983	Jan. 1, 1984
Developmental	3,064	1,719	3,946	4,207	1,500
Operational controllers	13,311[1/]	4,872[2/]	4,782[2/]	8,764[2/]	12,500[2/]
Controller total	16,375	6,591	8,728	12,971	14,000
Controller staff	900	635	643	623	800
Team supervisors	2,118	2,171	2,149	2,085	2,021
Assistant chiefs	315	337	344	334	327
Other facility management	1,332	1,204	1,224	1,175	1,139
Flight data aids	-	-	-	-	-
Total	21,040	10,938	14,555	18,655	19,754
Military	-	715	715	-	-
Total	21,040	11,653	15,270	18,655	19,754
Available control staff	13,311[3/]	8,131[4/]	8,036[4/]	11,915[4/]	15,478[4/]

1/ Includes only full performance level (FPL) controllers.

2/ Includes FPL controllers and developmental controllers checked out on two or more positions.

3/ Includes only FPL controllers

4/ Includes all operational controllers, all team supervisors, and one-half the controller staff, one-half of the assistant chiefs, and one-half of other facility management.

The Safety Board believes that the sequential change may decrease the value of the training center's radar training facility as a skill appraisal tool. Center personnel stated that the radar training course enabled them to identify trainees who had the potential to work at high-density facilities. If this is true, the sequential change would delay the identification of above-average trainees who could be assigned to more demanding facilities. However, the current practice is to assign a student to a facility before the person is evaluated at the center. As a result, the center's potential to provide accurate trainee evaluation and to influence initial assignments is not being used. Training personnel at the center cited examples of developmental controllers who had shown potential for radar control duty in high-density traffic TRACON's yet were being assigned to VFR towers. Center personnel stated that a student's grade and instructor evaluations were forwarded to the region for its use. In fact, one region requested that this practice be discontinued. The Safety Board believes that more emphasis should be placed on the capability of the center to evaluate and recommend placement of trainees. An assignment procedure based on center evaluations should reduce the facility failure rate and make controllers operational in a shorter time.

The en route speciality training is conducted in 13 phases; Phases 1 through 4 are conducted at the center and Phases 5 through 13 are conducted at the field facility. Phase 4, Radar Air Traffic Control, is identical to Phase 5 of the terminal specialty. This phase also has been rescheduled sequentially in a manner similar to that in the terminal specialty curriculum in order to better correlate the radar training with the field training. The Safety Board believes the change is as equally valid in this specialty training as in the terminal specialty training. As a result, the initial en route specialty training at the center has been shortened to 11 weeks 3 days.

The terminal and en route specialties historically have resulted in a failure rate of 26 percent and 33 percent, respectively, for the portion of instruction conducted at the Mike Monroney Aeronautical Center. The high failure rates suggest that the FAA's selection standards for new controllers may be inadequate. The Safety Board realizes that a new preadmission screening test was put into use in October 1981 by the FAA. The new test is supposed to reduce the failure rate at the training center. The FAA intended to improve the selection criteria in order to improve the efficiency of controller training and to increase the controller workforce in a shorter period of time by reducing the wasted training effort expended on trainees who cannot successfully complete the course of instruction.

In general, there have been no significant modifications of the existing facility training programs to qualify controllers to the full performance level. The curriculum, training procedures, and performance standards have not been changed from prestrike programs. Only two areas of training and qualifications were changed: the time necessary to complete the training requirements for full performance level, and the emphasis on achieving operational controller status. Facility supervisors and training personnel stated that these modifications of prestrike methods in fact increase the efficiency of the training program without affecting proficiency or safety.

The first change in training methods was to provide identical training to the replacement controllers at an accelerated rate. All facility supervisors stated that the previous training programs were spread over the time required to promote an individual to the full performance level. Many facility managers and training officers expressed the opinion that a full performance level of proficiency could be reached by the average developmental controller in about 24 months and that a new controller probably would be able to attain an operational level of proficiency at a radar position after 6 to 8 months of

training. The supervisors and training officers stated that the current rate of progression did not represent any real change from previous practice, since most controllers would have been trained to the full performance level earlier had it been possible to promote them under the program in effect before August 3, 1981.

The second change involves the adoption of the classification "operational controller." As defined, an operational controller is a full performance level controller or a developmental controller who is certified on two or more radar sectors or control positions. Before the strike, a developmental controller would train on a sector or position, become certified, and move to the next sector. This rotation would continue until the developmental controller was certified on all sectors in an area of specialization and the full performance level was reached. The present policy is one of temporary specialization at many of the most severely affected facilities. Now a developmental controller who has been certified on two radar sectors will remain on those sectors rather than moving on to train on new sectors. The result is an operational controller who is fully qualified to control traffic, but who does not have the flexibility to be used throughout the facility. Consequently, the present practice involves an acceptance of reduced flexibility but not reduced qualifications of a controller. It is intended, however, to eventually qualify the operational controller at all sectors as a full performance level controller. The program gives the facility the capability to train more individuals since the operational controller does not continue to need the supervision of a full performance level controller for on-the-job training. It also increases the number of controllers qualified to work particular sectors.

While the Safety Board's investigation found these modifications to the training programs were not causing any safety problems, the investigation did suggest problems that may be encountered in the future. One concern with regard to the poststrike training and certification of developmental controllers is that the training is being administered under controlled traffic conditions. The developmental controller conceivably might not be capable of handling heavy traffic at a later time. While an examination of the training indicated that it was not restricted to periods of slack traffic and, in fact, the per-hour traffic count at many facilities at times reached prestrike levels, traffic workloads generally do not involve the very heavy peaks found in prestrike overloads, because of controls in the ATC system and because developmental controllers often are training under less arduous conditions. The Safety Board believes that if traffic density continues to be managed properly, any problems created will be short-term and allow the developmental controllers to build up proficiency. However, it is clear that the controller qualification procedure must be closely monitored by first-line supervisors and facility managers.

Another concern which has been voiced is that at most facilities evaluation and proficiency development specialists are working as controllers to provide the total number of controllers required to control aircraft at the facilities. It is questioned whether the evaluation and proficiency development specialists will be able to conduct quality training programs while at the same time contributing to maintaining acceptable levels of operation. The FAA is of the view that complete, quality training of replacement controllers can be given high priority and can be accomplished while maintaining safe ATC operations. However, some facilities including Chicago, Boston, New York, and Minneapolis ARTCC's, and Lambert International Airport, St. Louis, Missouri, will have problems training new controllers because of a shortage of personnel. Working controllers at some facilities believed that traffic will have to be reduced to allow on-the-job training to be performed with the current staff levels.

Another concern which was explored is the effect of the demands of on-the-job training on the controller workforce. The bulk of developmental controller training continues to be one-to-one on-the-job training with a full performance level controller. This training, according to most supervisors and controllers, imposes additional workload and stress on the instructor. Some working controllers told the Safety Board that they would not train new controllers because they did not like the task and because it was tiring. Before the strike there were sufficient controllers to conduct on-the-job training without placing a significant burden on a few individuals. However, the current on-the-job training duties fall on fewer controllers. Consequently, individual facilities will be faced with scheduling large amounts of on-the-job training with a limited number of full performance controllers.

A concern of some training personnel involved the training of new developmental controllers at Level IV and V facilities (see appendix A). Many Level IV and V facilities were not equipped to conduct initial training (Phases 6 - 9) for new developmental controllers because in the past only experienced higher grade controllers were assigned to the facilities. Most training officers stated, however, that they could conduct this training if proper materials and assistance were provided.

A major concern of the working controllers interviewed was the fear that the crash program to recruit the replacement controllers will result in accepting substandard applicants. Their feeling was that time and training assets are too limited to be wasted on marginal applicants who will not qualify. The Safety Board shares this concern. Although the previous and current selection standards were not specifically evaluated, the historic and the first post-strike class failure rates at the training center indicate that significant improvement is necessary to insure that qualified candidates are selected for training.

The training program now in progress is the foundation of the future ATC system. The major challenge to the FAA in the next 3 years will be to maintain the quality of the training program with the limited controller assets available, while operating a safe, efficient ATC system. The FAA must be ready to limit the growth of the ATC system to accommodate effective training and must guard against any temptation to reduce training for the sake of increasing the controller workforce level.

There were 93 trainees in the Mike Monroney Aeronautical Center on August 3, 1981. Twenty-nine trainees graduated in August. Of the other 64 trainees, 29 failed Phase 4 training and were separated from the center. Although this is the only example, the 45 percent failure rate for the first class after the strike seems to indicate there was initially no change in the FAA standards for course completion.

On August 17, 1981, the FAA issued Announcement FAA/ATC-1 stating that the agency would accept applications for the position of air traffic controller. The qualification requirements were the same as those in the last prestrike announcement.

Starting September 30, 1981, and ending September 29, 1982, the center is programmed to accept 2,160 terminal specialty trainees. By January 15, 1983, these terminal specialty trainees will have been trained. The number realistically will be reduced by about 26 percent (historical terminal specialty attrition rate). Consequently, 1,598 trainees can be expected to start as developmental controllers at the field facilities between mid-1982 and January 1983. Another 6 percent or 96 developmental controllers may be lost during the facility training. Based on these data, about 1,502 terminal specialty trainees can be expected to achieve at least minimal operational controller status by September 30, 1983.

Additional controllers are projected to arrive at terminal facilities after January 1983 at the rate of 201 per month. By December 31, 1983, 2,211 additional new developmental controllers will be in the system. It is possible that as many as 603 of them will reach an operational controller status by the end of 1983. Therefore, the maximum number of newly trained operational controllers expected in terminal facilities by the end of 1983 is about 2,105.

The center will enroll 3,960 en route specialty trainees between August 11, 1981, and December 20, 1982. Based on the historical attrition rate of 33 percent, about 2,654 will be assigned as en route developmental controllers. Thereafter, based on an attrition rate of 9 percent, about 2,414 of these will attain an operational controller status by December 31, 1983.

Each month after December 1982, about 175 en route specialty trainees will arrive at field facilities, for a total of 2,100 new developmental controllers in 1983. It is possible that as many as 700 of them will reach an operational level by December 31, 1983. By mid-1984, most of these controllers should reach operational controller level. Thus, the maximum number of newly trained operational controllers that can be expected in ARTCC's by December 31, 1983, is about 3,114.

Based on these data, it is likely that by December 1983 no more than 5,219 new developmental controllers can be upgraded to operational controller status. When this number is added to the 6,591 controller staff on board on September 27, 1981, the most optimistic projection for the number of operational controllers by December 31, 1983, is about 11,810. This figure differs from the FAA's projection of 12,500 operational controllers by about 690 controllers. However, the total available control staff (see table 5) available to the ATC system by that date is likely to be the FAA's projection of 15,478 minus 690 or 14,788 persons, which is larger than the prestrike journeyman force.

The controller workforce has had a 7 to 9 percent loss annually due to retirements and separations. (The projections of those eligible to retire are in appendix C.) It is impossible to estimate the retirement rates for the future since many controllers stated they will remain until the system is rebuilt.

The FAA has projected 12,500 as the number of operational controllers necessary to staff the ATC system. The Safety Board believes that this number of controllers probably will not be available until mid to late 1984. Therefore, until mid-1984, the traffic capacity of the ATC system will be limited, and to some degree personnel will be on extended work weeks, and ATC staff and supervisory personnel who did not control traffic before August 3, 1981, will have to continue to perform controller duties. The Safety Board believes there will be a need for particularly strong FAA flow control management until the ATC system is fully staffed.

As of October 8, 1981, 522 persons who had previous military controller or ATC experience had been hired under a special program that allowed them to be assigned to field facilities as developmental controllers without initial training at the training center. Additionally, as of October 8, 1981, 192 qualified persons had been hired to fill the positions of flight data specialists; 156 of these persons were furloughed airline pilots, 13 were ex-military controllers, and 23 were other qualified persons. While these new employees will reduce the time to reach the projected level of 12,500 operational controllers, they will not decrease the timeframe appreciably.

The Department of Defense provided about 810 military controllers to the FAA in the first weeks of August. In late September 1981, an additional 190 military controllers were requested by the FAA.

The military controllers of all services undergo essentially the same initial training that FAA trainees receive. Thereafter, military facility training is similar to FAA training except for contingencies unique to military operations. All military controllers are required by their service to hold an FAA medical certificate and an FAA Control Tower Operator certificate.

Most of the military controllers were assigned to FAA terminal facilities since few had ARTCC experience (the military does not operate ARTCC's). However, some training of military controllers is conducted in FAA ARTCC's, and military controllers who had ARTCC experience were assigned to ARTCC's. Almost all the military controllers assigned to augment the ATC system had at least 3 years' controller experience.

With the exception of a few who were currently certified at particular facilities, no military controllers began controlling traffic immediately upon assignment to FAA facilities. All underwent standard facility training. They were initially assigned to noncontrol duties which spared qualified controllers to work control positions. They worked up through flight data and clearance delivery positions until, by mid-September, some began to qualify on radar and tower positions. The observations and statements of FAA supervisors and controllers were highly complimentary of the attitude and ability of the military controllers. A supervisor at Washington National Airport commented that the military controllers would routinely take work home to study in order to be prepared for the following day. Although no problems were found with the performance of military controllers, administrative difficulties were found. Some facility chiefs were reluctant to start formal training programs because they believed the military personnel would be assigned for only 90 to 120 days -- too short a time to realize continuing benefits to the facility from formal training. According to some military controllers, this caused a morale problem because they felt they were being relegated to menial administrative chores. The extended assignments of military personnel away from their duty stations, the long hours, and the salary difference between them and the FAA controllers further added to morale problems.

Prestrike Labor--Management Conditions

The Safety Board examined the operations of 45 ATC facilities in depth during the special investigation. (See appendix D.) One subject that surfaced at every facility the Safety Board surveyed was prestrike working conditions. Although the Safety Board did not specifically evaluate the effectiveness of prestrike management and did not document any specific safety problems associated with this issue, the Board believes this matter deserves discussion since many working controllers stated that facility operations had been made more stressful in the past by disruptive tactics by PATCO members. The alleged problems were stated in terms which indicated that they extended beyond usual labor-management disputes. Nonstriking PATCO members, nonunion controllers, and supervisors were unanimous in the feeling that "the pressure and problems left when PATCO walked out on August 3." The numbers of similar statements from working controllers indicated that the controller workforce was unsettled by the labor-management conditions. The conditions appeared, at times, to reduce the ability of individuals to work at full capacity. Under these circumstances, the efficiency and the safety of the prestrike ATC system might have been affected. The Safety Board highlighted some of the factors which were cited as labor-management problems so they can be eliminated by the FAA as the ATC system is rebuilt.

According to many facility personnel, the reason for the labor-management problems was the inability of the FAA management within some facilities to manage the controller workforce. This shortcoming of the FAA management has historical precedent and had caused problems in the past. However, the working controllers said that by 1981 the management in some facilities had become progressively more ineffective, and that

PATCO had a stronger voice in daily facility operations. According to some facility supervisors, the problems within the facilities were aggravated by the lack of support for facility management by regional and/or Washington headquarters staffs. This perceived erosion of management authority by first-line supervisors and the lack of facility management support in union matters discourgaged many supervisors from performing their management duties. As one first-line supervisor stated, "after bumping your head against a wall without success, you finally give up." It was the general impression of the Safety Board's investigation team that the prestrike management effort at many facilities was concerned to a large degree with resolving Fair Labor Standards Act issues and PATCO-induced paperwork.

The investigation indicated that many working controllers and supervisors were critical of the effectiveness of the FAA's prestrike management of the ATC facilities. The criticism extended to management in FAA headquarters, and at the regions, and to upper and middle management in the facilities. Finally, many working controllers believed that the first-line supervisors in the facilities had been ineffective in the prestrike ATC system. The data regarding the number of hours controllers worked controlling traffic before the strike and the grievances filed by the controllers support the belief that the management of the ATC system was ineffective before the strike.

Facility management at the chief and assistant chief level was characterized as aloof from, and mistrusting of, the controller workforce and the first-line supervisor. There were few lines of communication, and most complaints appeared to have been presumed to be invalid. Virtually all contact between management and controller representatives was on a confrontational basis.

First-line supervisors, who generally had the sympathy of the controllers who did not strike, were reportedly constantly "harrassed" by controller representatives with grievances, unsatisfactory condition reports, uncooperative attitudes, and other problems. Most controllers believed that the first-line supervisors did not receive sufficient support from the facility management. As a result, first-line supervision was often ineffective, and many supervisors admitted that they had stopped trying to fight against both sides. These were the individuals, however, who remained to work as controllers after the strike.

The most bitter complaints were directed at the lack of policy and management support that the facilities received from the regional and Washington headquarters. Facility managers and controllers alike stated that upper management did not support local management decisions on union affairs, disciplinary actions, or other substantive matters. The erosion of authority progressed to the lowest supervisory levels.

It appears that the management difficulties in the facilities subsided significantly after the controller strike. The comraderie that developed between the supervisors and the working controllers after the strike was reinforced by the side-by-side working conditions and the positive response by all individuals to the situation. However, as the system returns to normal and former roles are again restored, strong safeguards will be necessary to insure that similar labor-management problems do not develop again. All the problems cannot be blamed on PATCO; the FAA management practices and the basic philosophy of the operation of the ATC system must also be examined and rebuilt as normal operations are restored. There is no reason to conclude that the root problems that caused the strike have been solved, or that the FAA management of the ATC system will become effective.

The Safety Board is aware that the Administrator of the FAA has appointed a special task force to examine the labor-management conditions within the ATC system. We believe that this measure is an essential and positive step to identifying the causes of problems which existed and to establishing a basis for taking corrective measures.

ATC Facility Survey

At the 45 ATC facilities surveyed between September 1, 1981, and October 9, 1981, about 220 controllers and supervisors were interviewed formally, and informal discussions were held with many others. Controllers who were interviewed were selected by Safety Board investigators, and the interviews were held in private. Those interviewed included ATCO and nonunion working controllers, supervisors, regional staff, and facility staff who were controlling traffic; reemployed annuitants; and military controllers. Each facility visit lasted at least 1 day, while as many as 5 days were spent at some larger facilities. The review of records and documents was done on a random selection basis. At some facilities, 100 percent of the records were reviewed. The Safety Board received requests from individual members of Congress and from congressional committees to review the qualifications of specific individuals at some facilities. Additionally, allegations regarding unqualified controllers and unsafe procedures were received from other sources. Each allegation was reviewed by Safety Board personnel by record checks and personal interviews. In no case were the allegations substantiated.

Surveys of facilities were scheduled so as to observe different shifts and varied traffic loads. Investigators listened to transmissions at many sectors to monitor the facility operations. In some facilities, voice tapes from previous days were pulled and reviewed by Safety Board investigators.

ATC Procedural Modifications.--The ATC regulations and the FAA requirements which govern the manner in which aircraft are controlled were not changed after the strike. In almost every instance, prestrike procedures remained unchanged, although facility operations were reduced or combined to meet staffing limitations. Smaller towers with no radar capability were the least affected by controller workforce reductions. These facilities always had had a minimum number of positions which had to be staffed, so a combination of duties was a standard procedure. In ARTCC's and terminal facilities providing radar approach control, a variety of measures was taken to staff the necessary sectors or operating positions. In many instances, the plans were developed and implemented before the strike.

In ARTCC's and terminals, sectors and control positions were combined so that one controller could work a larger airspace area. At Atlanta ARTCC, the number of sectors was reduced from 39 to 28 before August 3. Seattle ARTCC went from 24 sectors to 14 to 16 sectors. Chicago ARTCC was severely affected by the strike; on August 3, the normal 44 sectors were reduced to 12 sectors resulting in each sector encompassing almost 4 times the prestrike airspace. As of September 10, staff levels at Chicago ARTCC had increased sufficiently to allow 20 sectors to be operated. Miami ARTCC went from 28 sectors to 20 sectors, while Washington ARTCC assumed control over some New York ARTCC sectors. Many of the major terminals combined sectors during the first days of the strike but gradually increased the number of sectors as personnel became available. The need to combine sectors will continue until staffing levels of operational controllers are increased. It is likely that combined sectors will be part of the system to some degree for at least a year.

Two important facts must be considered in evaluating the effect of combined sectors. First, combining sectors has been a standard ATC procedure. Sectors were combined routinely during the midshift and during periods of light traffic. This measure always resulted in one controller working traffic in an enlarged geographical area. The second fact is that, after August 3, traffic workload at each facility was metered by local and national flow control procedures. The effect was to limit traffic loads to

a level where the combined sectors had a manageable number of aircraft at any one time. During the first weeks, small general aviation aircraft were excluded from the ATC system, so the controller workload consisted strictly of forecast traffic. The major reason for the success of the ATC system in the first weeks of August was the planning for the combination of sectors and the limits placed on the traffic load by flow control procedures.

To understand why sectors could be combined successfully and sometimes drastically, it is necessary to recall that the FAA prestrike policy had been to staff ATC facilities for peak traffic conditions. The peaks were created by airline schedules which the FAA did not attempt to control until after the strike. For example, at one major airport 21 air carrier flights were scheduled to depart within 1 1/2 minutes. Because of this staffing philosophy, many controllers were not performing job-related functions during some periods of the day. Additionally, staff excesses were due to an inefficient system of sectors in ARTCC's. Moreover, the FAA had been planning a major resectorization of the ARTCC's. The resectorization is based on a 1978 study which indicated that there were too many sectors in many facilities, which resulted in an excessive number of controllers. The numbers of sectors will be reduced from about 709 to 557; the resulting reduction in personnel requirements should account for about 1,100 of the 3,000 controller reduction contemplated by the FAA's plans. Terminal facilities are not scheduled for resectorization, although many flight data specialist positions will be eliminated from terminal staffing levels.

Almost all of the other changes were management decisions to make operations more efficient and have not resulted in complaints of unsafe procedures from ATC users. Some of the changes noted were:

- o General aviation VFR advisories were reduced during heavy work periods or were refused altogether.
- o Many towers were closed or hours of operations were reduced.
- o Revised letters of agreements with military ATC facilities were developed which gave military ATC facilities more control duties.
- o New metering procedures were developed to control access of aircraft from local military and general aviation airports to the ATC system.
- o More reliance was placed on interfacility flow procedures as the principal means to regulate traffic.
- o Noise abatement procedures were suspended at some airports.
- o Increased emphasis to be placed on management's monitoring facility traffic loads.

Chicago ARTCC instituted a new procedure to monitor operations. A data systems specialist noted at 5-minute intervals the total number of tracks (aircraft) in the facility computer. A level of 150 to 160 tracks was established as a maximum capacity of the facility (during the day shift) based on controller workforce capability. Numbers of tracks above or below the target indicate traffic mismanagement. This procedure appeared to work. However, it did not appear to be common knowledge or procedure at other ARTCC's that were visited. The only difficulties encountered with the technique occurred during "surges" of traffic which concentrated the tracks in one position of the facility airspace.

ATC Facility Traffic Workload.--The traffic count statistics for the facilities surveyed are contained in appendix E. During August and September, the FAA announced that the system was handling between 75 percent to 83 percent of prestrike scheduled commercial flights. On October 6, the FAA announced that the 83 percent level was too high and that measures would be developed to reduce it to 78 percent by December 1.

The management of traffic levels in September was one of the major operational shortcomings noted during the investigation. Reviews of facility traffic logs and interviews with working controllers indicated that facility and controller workloads were increasing without a corresponding increase in controller workforce levels. Working controllers at some facilities stated that there were "too many airplanes and too few controllers." In view of the observed traffic increases and the effects on the controller workforce, the Safety Board issued safety recommendation A-81-146 to the FAA on October 14, 1981. This recommendation stated:

> In addition to recent efforts to reduce scheduled IFR traffic now operating under national flow controls, implement additional controls both at the national and facility levels which will reduce controller and facility workloads by limiting nonscheduled IFR operations and air traffic control and discretionary services being provided to VFR operations. (Class I, Urgent Action)

The September traffic increase concerned the Safety Board because it indicated an apparent lack of knowledge on the part of upper ATC management of the actual workloads in the facilities and an initial tendency by FAA management to yield prematurely to pressure to increase the system capacity. The reductions of scheduled commercial air traffic from 83 percent to 78 percent which were announced on October 6 and the General Aviation Reservations Program were positive moves to manage the system capacity. The management of the number of aircraft in the ATC system will continue to be the major determinant of whether the system is safe and efficient.

The limits on the capacity of the ATC system may result in increased numbers of VFR flights which would normally be flown under IFR. This situation will result in less positive control and more reliance on see-and-avoid concepts until the ATC system returns to the normal levels of air traffic capacity. The increase in the number of aircraft which are not under positive control because they are not flying IFR will require a greater alertness on the part of pilots and controllers in order to ensure that the maximum levels of safety are maintained under VFR see-and-avoid conditions.

The investigation of the facilities established that the national and local flow control procedure generally was effective with respect to scheduled air carrier, air taxi, and most IFR operations. However, recurrent traffic peaking problems continued to arise. In late August and September, the total traffic count in many facilities increased significantly. The traffic increase was not primarily the result of inadequate flow control procedures, but rather was attributable to a combination of increases in flow-controlled and non-flow-controlled IFR traffic, increases in VFR transient traffic, and the provision of additional services to VFR flights. As an example, the total operations at San Francisco International Airport were 27,635 in July 1981, when the facility had 21 full performance level and 5 developmental controllers. There were 24,626 operations in August 1981 and 25,331 operations in September 1981. Although air carrier operations were 82 percent of prestrike levels, the general aviation volume went from 2,837 operations in July to 5,133 operations in September. By September 26, 1981, the facility was staffed with 4 full performance level controllers, 7 developmental controllers recently transferred into the tower, and 15 supervisors. John F. Kennedy International Airport lost 85 percent of its operational controllers, yet a training officer reported that

at times the facility had moved 110 percent of prestrike traffic. The Cleveland ARTCC increased the traffic count from 73 percent of prestrike levels in August 1981 to 86 percent in the first 21 days of September 1981. The Cleveland ARTCC had 38 percent of the prestrike controller force available on September 30, 1981.

The Safety Board realizes that it is possible to handle a large number of aircraft if the flights are spread over a period of time. However, in September and October 1981 our investigators observed that many working controllers were increasing their workloads by volunteering additional services or by accepting transient aircraft at high-density airports. Although a helpful attitude on the part of individual controllers results in more services to more pilots, there is evidence that individual controllers may fail to understand the effects of the additional workload on controllers in adjoining sectors or on the facility and national flow control procedures. As a result, the good intentions of the controller workforce may tend to reduce the effectiveness and safety of the flow control concept and to overtax the current ATC system. Of course, this additional workload may have both short- and long-range effects on controller fatigue and stress.

Generally ARTCC working controllers did not note an increase in Mode C transponder returns indicating flights above 12,500 feet. The exceptions were the Denver, Chicago, Los Angeles, and Oakland ARTCC's. Denver and Los Angeles controllers indicated that these aircraft did cause additional workloads. However, the provision of discretionary traffic advisories of Mode C intruders to IFR flights could not always be made because of workload.

None of the working controllers or supervisors at any facilities reported complaints by pilots or problems resulting from providing ATC services to general aviation or corporate aircraft. In support of this observation, the numbers of emergencies and pilot assistance requirements decreased or showed no increase from prestrike levels. However, several working controllers observed that the weather had been good, and many general aviation pilots were intentionally not requesting non-essential ATC services.

With the exception of the Atlanta, Jacksonville, and Miami ARTCC's, no ARTCC was able to accept prestrike levels of general aviation or corporate operations nor did any of them expect to be able to handle prestrike levels for 1 to 3 years. Most ARTCC managers believed that 60 to 80 percent of prestrike general aviation traffic would be standard until significant increases in the workforce were achieved.

Generally, the terminal facilities had more optimistic views of general aviation increases. Many supervisors stated that they could increase operations at any time, but they were very dependent on adjoining ARTCC capacity. Most major terminal supervisors believed they would be capable of 100 percent of prestrike levels in 1 to 2 years. They observed, however, that this capability depended on how long the military controllers remained to augment the facility workforce. Small towers had no specific data on this question since many were not affected significantly by national flow control operations and because practice approaches/touch and go's could be controlled by the facility without affecting the ATC system.

Military flying affected the system differently depending on the geographical area. Generally, most facility supervisors noted that military operations decreased or switched to VFR operations and lessened their impact on the ATC system. The Oakland ARTCC, which was affected the most, established new procedures to minimize adverse effects. Some controllers noted that there was an increase in high-speed military flights which had flown IFR before the strike going VFR to training areas. Boston and Jacksonville ARTCC's reported that military flights of multiple aircraft which had gone in formation and returned separately before the strike had adopted the practice of returning as a single flight.

A review of the facility records indicated that the prestrike per-hour and per-day IFR traffic volume at some facilities had been reached and exceeded on many occasions. The Oakland ARTCC, for example, recorded 4,679 operations on September 25. The prestrike average traffic count was 4,000 to 4,200.

The perspectives of the supervisors regarding the traffic workloads were that the facility was managing the traffic workload and that the system was safe. All working controllers expressed the view in varying degrees that the system was safe, but most had comments on the actual numbers of aircraft they were required to handle. The difference of perspective was subtle, but it seemed to represent the fine line between the management view and the worker view. The working controllers were concerned with the individual workloads while the supervisors were concerned with the facility workloads. There did not appear to be a clear appreciation that controller workloads dictate facility workloads, and that it was possible to operate the facility below average traffic levels yet still overload a specific sector or area of specialization or another adjacent facility.

Generally, prestrike management measures at facilities with regard to monitoring maximum levels of traffic have not been revised. The responsibility continues to rest with first- and second-line supervisors to manage controller tasks and to monitor and implement local flow control procedures.

Controller Certification and Proficiency.--FAA Handbook 3120.4 specifies certification and proficiency requirements for FAA controllers. (See appendices B and F.) In order to work a position or a sector, a controller must meet the requirements of a Class II medical certificate and be certified on the position or sector. A controller must control traffic for 8 hours every 30 days at each radar position, or 8 hours each 90 days for each nonradar position to remain current.

The review of the training records revealed that many staff and supervisory personnel were recertified in late July and the first half of August. Each of the training records was evaluated to determine if the recertification appeared to have been properly accomplished. In every instance where a staff or supervisory person resumed controller duties in the home facility, the training record indicated a 4- to 12-hour supervised checkout at the position. The training was conducted in 1- to 2-hour increments and usually signed off by more than one full performance level controller. The Safety Board paid particular attention to the experience level of the working controllers to determine if the work background and experience were consistent with the time required to check out. No discrepancies were noted.

At the Chicago ARTCC, 7 of the 13 staff persons who reported to work traffic on August 3 were not current. As a result, they were required to work under the supervision of a qualified controller. This shortcoming was the result of the failure of the ARTCC training officer to establish a program to get all staff personnel qualified as he had been directed by the ARTCC chief.

Although it was apparent that recertification programs were conducted before staff and supervisory personnel resumed controlling traffic, many of the individuals just met the recertification requirements. Their high experience level plus the recertification training enabled them to control a limited amount of traffic safely. Many controllers and staff/supervisory controllers stated that it required about 2 weeks for the recertified controllers to regain proficiency. Some of these individuals indicated that the first 2 weeks were "shakey" because many of the personnel were "rough and slow." Additionally, some of the supervisory controllers were attempting to perform at levels

which were beyond their capability. This observation is supported by the higher numbers of operational errors, operational deviations, and near midair collisions that were reported in the first 2 weeks of the strike.

Several experienced controllers stated that the supervisors were performing better than they had thought was possible. The supervisors soon "came up to speed" and the teams were working well. In many instances, the supervisor/employee roles had been reversed since the former supervisor was generally dependent on a former subordinate for advice, guidance, and assistance. Several working controllers stated that the performance of the supervisor as a controller reestablished their respect for the supervisor.

The Safety Board devoted specific attention to the use of military controllers, newly hired employees, reemployed annuitants, and miscellaneous personnel who were alleged to be performing control duties without sufficient training. There were no instances discovered of any of these personnel performing unauthorized control functions. Most were used to perform duties that would spare operational controllers to work positions. Many of these persons worked transporting flight strips, answering telephones, or performing other administrative duties. The "A" side controller in the ARTCC or the flight data specialist position in the terminals were predominantly the positions filled by these individuals, although there was some modification in the duties of these positions. Each of these positions involve noncontroller functions which can be performed with little training. Most reemployed annuitants performed training and administrative duties. The 54 who qualified for recertification and passed a Class II medical examination were assigned as controllers. None of the latter had been retired for more than 3 years.

Proficiency of a controller is a very subjective area because many skills must be used daily in varying ways to meet different situations. The only practical measure of proficiency is the observations of the team supervisor. In addition to these observations, FAA Handbook 3120.4 requires a semiannual over-the-shoulder training review to identify areas of performance deficiencies. Two points were noted with regard to the over-the-shoulder evaluations. First, many facilities had stopped administering over-the-shoulder evaluations because of staffing shortages, and second, every supervisor and controller interviewed considered it a worthless paperwork exercise.

The Safety Board had been concerned with the methods used by the FAA to test controller proficiency. The subject was discussed in a Special Investigation Report that the Safety Board adopted on September 24, 1981. 8/ In the report, the Safety Board forwarded the following recommendation to FAA:

> When an improved simulation system is acquired at terminal facilities, require controllers to periodically demonstrate a predetermined level of skill similar to the manner in which the FAA requires air carrier pilots to demonstrate proficiency on aircraft simulators. (Class II, Priority Action) (A-81-133)

The Safety Board could find no written waiver of the over-the-shoulder requirements. In fact, the number of interpretations of the over-the-shoulder requirements and the fact that the training officer at the Chicago ARTCC had only an outdated Handbook 3120.4 indicated that this aspect of the training and evaluation program was either deficient or regarded to be unimportant even before the strike.

8/ Special Investigation Report--"Aircraft Separation Incidents at Hartsfield Atlanta International Airport, Atlanta, Georgia, October 7, 1980" (NTSB-SIR-81-6).

The concept of the over-the-shoulder evaluation is valid if managed properly. The FAA Handbook directs that it be performed by the controller's first-line supervisor, or if a facility training specialist performs the over-the-shoulder evaluation, that the supervisor is to be present. The prestrike effectiveness of the procedure appears to have been hampered by favoritism and, as administered, was of little value.

An argument against an independent over-the-shoulder-type evaluation by facility or regional staff is that the individual conducting the evaluation might not be familiar with the specific tasks. However, the Safety Board believes that a properly designed evaluation method is attainable and is necessary to insure standardization of procedures and operations.

Computer and Equipment Problems--The number of unscheduled computer interruptions fell off significantly at almost every facility after August 3. For the months of August 1979, 1980, and 1981, the total interruptions per week were 8.27, 6.62, and 4.73, respectively, for the 20 major ARTCC's. Similar figures at terminal facilities could not be compared because of equipment changes and modifications during these years. However, the majority of the working controllers from these facilities stated that equipment performance was satisfactory.

Interviews with facility personnel did not provide conclusive evidence of improved equipment reliability. Some suggested that before the strike some controllers were abusing the computer systems, which resulted in interruptions. Many suggested that there were fewer aircraft and fewer flight plans stored, and, most importantly, program updating and revisions were restricted during August and September. In the past, incorrect programs occasionally caused malfunctions during the update or maintenance phases. Statements by FAA personnel in Washington headquarters indicated that while computer interruptions were down significantly, much of the reason was improved use of the system rather than any previous misuse. The important finding, however, was that computer reliability improved during the first months of the investigation.

The allegation was made in many facilities that before August 3 many controllers were putting unnecessary information in facility computers. Although the Safety Board was unable to substantiate this allegation, if this is true, the FAA must eliminate the possibility of a similar abuse developing in the future. An awareness of the possibility is especially critical in the rebuilding years.

Controller Workforce Use.--Statistical data on the effect of the strike on major facilities are contained in appendix G. In view of the magnitude of the strike, the logical question was "how can the system operate with a large percentage of the workforce gone?" The answer in part lies in the preplanned actions previously referenced: recertification of qualified staff and supervisory personnel to provide replacement personnel, limiting and metering traffic flow, combining sectors, augmentation with military controllers, the use of operational controllers in a limited number of sectors and deferring their full performance level qualifications programs, and the assignment of supporting duties to other than operational controllers.

There were other important reasons. The most significant was that the facilities may have been overstaffed by as much as 30 percent because of the philosophy of manning the facilities for peak traffic periods and inefficient over-sectorization. Most supervisors expressed this opinion and generally agreed on the estimated percentage. Another reason was that the extension of the workweek to 48 hours alternating with 40 hours increased the effective number of controllers. Moreover, since the controllers worked a sector up to 7 hours a day compared to the 3 1/2 to 4 hours common before the strike, the effective number of controllers was also increased.

Nearly every facility chief stated that there was a blatant abuse of sick leave by the controller workforce before the strike. Some facilities were averaging 100 percent of the accrued sick leave, while most facilities averaged about 80 percent sick leave usage. This compares to a government-wide average usage rate of 68 percent. The Atlanta and Jacksonville ARTCC's reported 105 and 110 percent of accrued sick leave usage at times before the strike. Since August 3, the use of sick leave and annual leave has decreased significantly. Although some facilities have granted spot annual leave, the sick leave rate has remained very low through August and September. This factor provided additional control hours for the entire system and accounts, in part, for the ability of the system to maintain a high volume of traffic with a reduced control force.

About 90 percent of the working controllers stated that more traffic could be handled than was expected because of the attitude of cooperation within the facilities and between the pilots and controllers. Handoffs and coordination were more efficient and faster because control personnel were anticipating coordination actions and they responded immediately to coordination requests. Additionally, requested assistance was provided more quickly. Overall, they said that the system is more efficient because everyone has a single, work-related purpose.

The main poststrike problems concerning the controller workforce relate to the length of the workweek and the workday. As early as the first week in September, the FAA announced that the maximum workweek which would be scheduled was 48 hours. The investigation indicated that while no more than 48 hours might be scheduled, working controllers at most facilities would work a few hours additional overtime each week. Workweeks of up to 50 to 52 hours were not uncommon. Between September 6 and September 12, five Chicago ARTCC controllers worked between 52 and 56 hours. Four of them worked consecutive, back-to-back, 10-hour days while one worked 3 consecutive 10-hour days.

ATC Facility Supervision and Management.--Poststrike supervisory procedures varied in each facility that was surveyed. The concept of a team supervisor supervising several controllers remained the basic management structure when sufficient controllers were available to staff the required positions. However, few facilities were able to staff the areas of specialization and still provide prestrike levels of operations and first-line supervision. As a result, a large percentage of the working control force consisted of supervisors and facility staff with no apparent first-line supervision. Every facility attempted to provide a first-line supervisor, regardless of the makeup of the controllers who were being supervised. This was not always possible, however, and there were many instances where there was no first-line supervisor designated. The Chicago ARTCC reported it had so few full performance level controllers that all supervisory and staff persons had to control traffic. As such, no first-line supervisory positions were being manned. This situation was common in varying degrees in many facilities.

Facility management recognized that first-line supervision was lacking, and whenever an area of specialization was staffed without first-line supervision, procedures were initiated to provide some degree of supervision. Some facilities designated a roving supervisor to circulate throughout the control floor to monitor operations and provide assistance as required. Other facilities designated assistant chiefs or reemployed annuitants to perform supervisory duties. These practices reduced the effectiveness of first-line supervision because the acting supervisor was spread over a larger area of responsibility and may not have been able to deal with each situation as well as a regular first-line supervisor. However, the procedures did provide a designated individual in the area who was responsible to the working controllers.

The most common practice, however, was to designate a working controller as the first-line supervisor. The dual assignment of duties, especially during periods of moderate or heavy traffic, reduced the effectiveness of first-line supervision unless appropriate

procedures existed to provide assistance to the controller/supervisor. Such a situation arose during the investigation when our investigators observed "a first-line supervisor" who was also working a control position that had a heavy traffic load. The supervisor was unable to perform supervisory duties, and there was no other person in the area to provide assistance or backup supervision. When the traffic load forced the controller/supervisor to request controller assistance at his position, 4 minutes elapsed before another controller was able to assist him. Procedures for having first-line supervision immediately available for assistance and coordination are critical to the ATC system and must be a part of each facility's planning.

As a result of these facts, on October 14, 1981, the Safety Board issued the following recommendation to the FAA:

> Require that, at any time that a first-line supervisor is to work a control position in addition to performing supervisory duties, a procedure is in place at the facility through which qualified personnel are immediately available for assistance or coordination. (Class II, Priority Action) (A-81-147)

The Safety Board believes that the importance of first-line supervision will grow significantly in the next 3 years. In this time there will be a 50-percent increase in the controller workforce. This rapid assimilation of new controllers will require levels of supervision not provided before the strike. The requirement for large-scale, on-the-job training programs will place additional workload on full performance level controllers. Consequently, the supervisor will have a larger responsibility to monitor workloads and to insure that procedural errors do not result. The reliance on flow control procedures requires coordination between sectors and facilities. The first-line supervisor is the individual that all facility managers look to coordinate the workloads and to monitor controller proficiency. As a result, the role of the first-line supervisor will become more demanding as the rebuilding process develops. It is important that the FAA recognize the new demands on its supervisors and take measures to assure full time supervisors are available and to establish and maintain the authority of first-line supervisors.

Supervisors generally reported that they controlled traffic about 5 to 10 percent of the time in an average month before the strike in order to maintain certification. During August and September most supervisors controlled traffic between 80 and 100 percent of the time. There were local exceptions, however, based on the total controller workforce.

ATC Problems with Canadian ATC Personnel.--Canadian air traffic controllers stated that the ATC system in the United States was unsafe after the strike. They reported many alleged unsafe conditions, and occasionally refused to handle aircraft coming from the United States. The allegations of safety hazards concerning Canadian airspace were examined at Boston and Seattle ARTCC's. The allegations generally related to airspace and procedural violations which, in fact, were mostly related to estimated time of arrival (ETA) problems. Some not-"by-the-book" procedures that were accepted before the strike brought complaints of unsafe practices after August 3. ETA complaints involved the failure of U.S. controllers to update times when there was more than a 3-minute difference from the flight plan time. Additionally, Canadian controllers began adding to workloads by updating ETA's by 1 or 2 minutes. A Safety Board investigator observed a Vancouver controller update an aircraft ETA by 1 minute.

The Seattle ARTCC was not affected as severely by the strike as most ARTCC's; 54 percent of the control staff remained on duty. As a result, many of the same controllers were coordinating with the Canadian controllers before and after the strike.

Boston ARTCC was more severely affected, yet the controllers who worked with the Canadian controllers before the strike were the same ones who were alleged to have committed an increased number of errors. Generally, the controllers at the two ARTCC's stated that the working relationship with the Canadian controllers improved considerably in September.

Stress and Fatigue

The reduction of the controller workforce had a significant effect on the work schedules of the remaining controller staff. The relationship of the new work requirements and conditions to controller fatigue and stress level, and the resulting effect on safety were examined in the investigation. The issues were analyzed through a two-fold approach. The field survey team raised the questions of fatigue, stress, workload, and general effects of the working conditions in the facilities. A separate group of investigators examined the FAA methodology and programs to estimate and monitor controller stress, workload, and fatigue, and its effect on performance; to assess the short- and long-term health effects of the current working conditions; and to assign and control controller workloads. Several persons were interviewed, including senior management of the Air Traffic Service at FAA headquarters and FAA medical personnel.

Air Traffic Service management personnel stated that decisions concerning the length of work schedules and individual workloads were administrative decisions based on "common sense" judgment. They believed that controlling air traffic had not been demonstrated to be overly stressful work, so no subjective process to assess workload or stress had been developed to monitor the poststrike controller workforce. They did not anticipate the need to develop a formal program in the future. Furthermore, they stated that the objective measurements indicated that the system was safe, so the effects of stress and fatigue were minimal. The objective indicators were, in part, operational errors, operational deviations, near midair collisions, midair collisions, and pilot deviations. They cited the benefits of flow control procedures and a lighter traffic workload as principal reasons for limited stress and fatigue factors.

An FAA manager in Washington, D.C., who was involved in the development of the contingency plan stated that the original 60-hour workweek was selected because this was a limitation in law. He further stated that neither the supervisors nor the FAA evaluation staff were given specific guidelines for identifying workload, fatigue, or stress problems.

The Federal Air Surgeon indicated that he was not overly concerned with the issues of stress, fatigue, or workload. He did state that high morale was a present favorable factor for the working controllers, and he expressed a concern for longer-term effects when morale might not be so high. He also expressed a concern that the adaptation to the changed work schedules would be harder for the older controllers. Furthermore, the Federal Air Surgeon indicated that he would prefer: (1) regular shift rotations, (2) a 40-hour week, and (3) resumption of vacations for controllers.

The Safety Board's investigation did not indicate that the general controller population felt that stress and fatigue problems had emerged as significant influences on their job performance or in their personal lives during August and September. However, about 6 percent of the working controllers did state that they had experienced an increase in fatigue and stress since the strike started. Most of these controllers had more than 10 years' controller service and one had been a controller for 27 years. The controller with 27 years' experience was interviewed in early October. He stated: "The system is safer now. You must consider the antics that were going on before the strike. I thought I could go 6 days a week for an indefinite period. But I am not sure now. We don't see any

help coming up. I am tired and usually someone else will work the heavy traffic radar on the 6th day while I work the light traffic sector."

Interviews with the current controller workforce did indicate that many of the individuals were apprehensive that the extended workhours and heavier workloads will produce fatigue and stress in the future, despite the fact they appeared to be coping with the current work situation. A major reason for future rather than present apprehension was that the controllers stated that the general spirit of user cooperation, teamwork, and a sense of job accomplishment had produced an emotional uplift which had offset the effects of extended workhours. However, there was a pervasive feeling on their part that the uplift was likely to be short-term, and that fatigue and stress might affect their performance in the future.

The following are the major points developed by the investigators regarding stress and fatigue:

- o About 62 percent of the working controllers characterized their workload as heavy during the first 2 months after the strike, while another 21 percent reported a moderate workload.

- o Over one-half of the working controllers at two major terminal facilities who were asked specific questions about levels of concentration reported that they had to devote nearly complete, constant attention during normal 2-hour shifts. The local control position demanded the most concentration.

- o Controller workload has been decreased by leveling off the peaks and lows in the aircraft traffic patterns to produce a constant moderate level of flow. With the traffic peaks and lows, a controller may have had a very busy period of work, but during a low period the controller could relax. During this break, the controller could recover from the effects of any stress or fatigue. In the current situation, a controller has to maintain a fixed amount of attention and concentration for longer periods of time without the "low-traffic break." As a result, fatigue may build up slower because of the level of traffic, but it could continue to accumulate because of the constancy of the traffic flow.

- o Some working controllers reported an increase of on-the-job-training duties. Training duties were more tiring than regular control functions and increased the workload at the position.

- o Over 90 percent of the working controllers and supervisors stated that crossing the union picket line was stressful.

- o About 40 percent of the working controllers stated that the extended hours and workweek and the erratically changing shifts affected their family and personal lives. Although some enjoyed the extra pay, many considered the time off more valuable.

- The pay cap appeared to anger many working controllers and supervisors not controlling traffic who said they were working part of each week for free. 9/

- Ninety percent of the working controllers were apprehensive about the quality of the new controllers. Most of them also stated that the continuing influx of a large number of new controllers would cause some apprehension until each individual demonstrated the necessary skills.

- A major concern of most working controllers was that the striking controllers would be allowed to return. This concern caused most controllers to do everything possible to make the system operate smoothly in order to eliminate all criticism by system users. This particular motivation was a constant drive in most controllers and caused increased workloads for some controllers.

- Labor relations problems bothered some working controllers. Although friction was minimal, many stated that some of the issues that caused the strike did not leave with the striking controllers. Many stated that they hoped the new system would be receptive to solutions to old problems.

- Some working controllers reported being told by management that if they did not like the work conditions they could quit and join the strikers.

- Some working controllers felt they were working hard and extending themselves for the system and the nation. However, they believed they were not receiving the recognition from the FAA that they deserved. Most referred to the bad media that the system and the working controllers were receiving.

- The feeling of uncertainty about the future--when the system would return to normal, when and how the military controllers will be withdrawn, and the personal and job-related issues already mentioned--could be very stressful to many individuals and could have a harmful effect on the rebuilding process.

The majority of the working controllers and supervisors appeared to have very high morale that was helping to carry them through this period. The current workforce said that for some time before the strike, there was a great deal of peer pressure from PATCO members and some controllers expressed the thought that they had been concerned that the controller sitting next to them would involve them in an error or some other problem. The atmosphere was described as very tense and not a good working environment. For most of the current workforce, the atmosphere is now perceived as pleasant and they do not mind working harder in terms of workload or hours. The current workforce believes that they are doing an important job in an emergency situation. Most working controllers indicated that they believe they can do what is necessary until the system returns to normal.

The Safety Board is concerned that the long-term effects of the current work schedules will lead to fatigue and stress, which may eventually degrade controller efficiency and aviation safety. Based on our investigator's discussions with the Federal Air Surgeon and management officals of FAA's Air Traffic Service, we conclude that no

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9/ A government employee may not earn more than $50,112.50. Although controllers may exceed this figure with overtime, certain night and Sunday pay benefits are lost once the pay cap of $50,112.50 is reached.

national or regional guidelines have been disseminated by the FAA to ATC facilities to assist first-line supervisors in detecting the emergence of fatigue and stress. Some facilities have informal programs. Two ARTCC's reported programs that are monitored by regional flight surgeons. At two other major facilities, the program consists of the team supervisor or chief looking for signs of fatigue and stress. These were the only two facilities which reported noting problems with controllers. At one facility, a supervisor stated that they gave the affected controller 2 days off each week while at the other facility the team supervisor and assistant chief increased their monitoring of the controllers' performance.

To prevent any adverse effect on aviation safety, the Safety Board believes that an appropriate fatigue/stress detection program should be initiated in each ATC facility. For such a program to be effective, all ATC supervisory personnel should be instructed to recognize the early warning signs of fatigue and stress. As a result of our concerns in the area of fatigue and stress, the Safety Board issued the following recommendation to the FAA on October 14, 1981:

> Establish and implement a program to detect the onset of, and to alleviate, controller fatigue and stress. (Class II, Priority Action) (A-81-145)

Industry Survey of the ATC System

The Safety Board sent a questionnaire to 89 companies and organizations engaged in all facets of aviation operations requesting information on (1) ATC hazards that had come to their attention, (2) any actual or potential procedural problems, (3) the efficiency and safety of the system, (4) any operational procedures and reporting systems instituted by the organizations to detect and eliminate ATC problems, and (5) any recommendations on the future operation of the ATC system. The questionnaires were sent to airline and commuter airline management, airline pilot associations, airline pilot safety representatives, airline dispatcher associations, airport operator associations, ATC specialist associations, general aviation pilot associations, the larger corporate/executive aircraft operators, and Department of Defense agencies. A second questionnaire was distributed to general aviation pilots at various fixed-base operations. About 700 general aviation questionnaires were distributed. In addition to these sources of data, investigators visited airline managers, the Air Transport Association, the National Business Aircraft Association, the Commuter Airline Association of America (now the Regional Airline Association of America), and the Aircraft Owners and Pilots Association to develop an understanding of the effect of the curtailed ATC system on the aviation industry. Additionally, more than 125 trip reports by Safety Board investigators were analyzed. The trip reports contained observations of airline and ATC operations made while riding in airliner cockpits. Finally, FAA surveillance reports of ATC facilities and of airline operations, as well as reports by FAA ATC evaluators, were reviewed.

The Safety Board received 34 signed responses from the 89 questionnaires mailed to aviation organizations. The responses to the questionnaires, as well as individual interviews, were almost unanimous in agreeing that the system, putting aside delays and the reduction of flights, was working as well, if not better, than before the strike. There were numerous comments about departure delays, but the respondents accepted the delays as the price of the strike. However, the comments received in September indicated longer delays and a lesser willingness to accept delays indefinitely. Most respondents stated that the system was safer than during the prestrike period.

Most airlines reported that the strike did not affect flight operations beyond the reduction in schedules and the departure delays. Some of the corporate/executive operators and the air taxi operators acknowledged that some flights which would have

been flown IFR before the strike were now flown VFR at times. One commuter airline stated that single-pilot charter flights now were flown with two pilots as a collision avoidance measure. Most respondents stated that flightcrews were cautioned to exercise additional vigilance and to pay strict attention to all ATC instructions. Most airlines increased reserve fuel requirements.

With regard to the efficiency and the quality of the system, almost all respondents indicated that, aside from ground delays, the system was satisfactory. The following comments generally represent the observations of the respondents:

- "Generally, system operation appears to be well organized and efficient. Increased spacing on departure and en route segments causes some delays under some weather and wind conditions, but once airborne, flights generally report routine handling and increased approval of requests for direct routings. We have no evidence indicative of any trend toward increased system errors, improper handling, or any other negative fallout resulting from the strike. In fact, flightcrew confidence in the system is quite satisfactory."

- "Any flight personnel I have talked to, in our organization and others, feel the quality of the system has improved substantially. The controllers now working have a much better attitude and seem to keep a better traffic flow even when restrictions are applied."

- "From an Operations Control standpoint, the overall quality of the ATC system now is an improvement over the prestrike system. The various components of the FAA, i.e., the centers, FSS [Flight Service Stations], towers have been especially cooperative with us and receptive to our needs and requirements. The personnel assigned to these areas have been and are most courteous and willing to assist in any way they can. This is a definite improvement over the prestrike atmosphere that prevailed."

- "There is much less harrassment of the aircrews by controllers who are the real professionals and it shows in less time/fuel wasting vectoring. Delays taken on the ground are much more efficient than those taken in the air."

- "All pilots indicate increased confidence in the overall ATC system, less conflict with controllers, and less errors in clearances issued, etc. Controllers are more willing to accommodate requests from flightcrews and in our area seem generally more organized."

- "We find the quality of the system to be very good. Reports from our flightcrews have been complimentary regarding the courtesy and professional attitudes and handling received."

None of the respondents said the present system was less safe than the prestrike system. Most indicated that the system was safer. The most derogatory comment was that "I feel the system is safe but not quite as safe as the prestrike system, but certainly 'safe-enough.'" This individual also reported he had encountered what seemed to him to be less qualified and less proficient controllers than in previous months. Other comments in the same vein were:

- o "Air safety appears to be as safe or safer now as it had been before the strike. We see a reduced number of aircraft in the air, more orderly acceptance of aircraft, less vectoring and holding and more calm and professionalism on the part of the controllers."

- o "We find no evidence of change in the degree of safety with the present ATC operating conditions. The reduction of demand on the system, particularly during peak operating hours, in our opinion offers opportunity for the enhancement of safe operations."

Many respondents did comment on increased VFR flying in marginal weather conditions and problems due to closed towers and special VFR clearances. The following comments illustrate the problems noted in the responses:

- o "Restrictive IFR capacity rules significantly impact the general aviation segment to the extent that a noticeable increase in VFR traffic, particularly above 10,000 ft., and in general at all altitudes, is apparent. With marginal VFR or IFR weather in a given area, more operations are now being conducted under VFR or special VFR, where in prestrike conditions these operations probably would have flown under IFR. In some cases, it would seem logical to assume that compromises may be being made when weather conditions affect a GO/NO-GO decision when an IFR clearance cannot be obtained; the option of a VFR departure in marginal conditions, therefore, may seem attractive to some operators, and even though in compliance with the FAR, may not necessarily provide the safest course of action. The impact on Air Carrier operations, particularly at nontower airports, is a need to reinforce crewmember vigilance for traffic at a time when the ATC system is in a most undesirable posture to provide assistance."

- o "The most significant observed and reported ATC related operational problems seem to be the unrestricted number of nonscheduled operations that frequently saturate the system or sectors within the system resulting in increased workload for the controller and a significant increase in departure delays for scheduled operators."

- o "We would like to see a management program put in effect to control the demand of nonscheduled operations on an FAA regional basis. We see a definite and immediate need for this to be accomplished particularly at high density terminals."

- o "The only significant problems we have observed are in relation to airports which are now uncontrolled due to closing of the control tower. The local traffic in these areas cannot be at all relied upon to follow reasonable procedures for operation in and around the airport. In addition the airport management, at the one station we are involved with, has not curtailed or restricted operations in any way to reduce the hazard of collision between light, noncommercial aircraft and commuters."

No respondent stated that FAA surveillance of air carrier operations had been affected by the ATC situation. In fact, any comments in this area were that surveillance had increased in the month of August.

The Safety Board received 147 signed and 21 unsigned general aviation questionnaires. Of these, 144 responses were categorized as positive. Many of the adverse comments were that general aviation pilots were alotted too small a share of the ATC system capacity. This was especially true during the first weeks when no IFR flights were approved for aircraft of less than 12,500 pounds gross takeoff weight. However, most general aviation respondents complained about long delays before clearances were issued. The consensus of the respondents was that more general aviation pilots were flying VFR now instead of IFR.

Most of the respondents were satisfied with the quality of the ATC procedures once they were able to enter the system. They stated generally that the working controllers were proficient, although there were several comments about specific flights where controller irregularities were noted. As with the questionnaires received from airline management, virtually all respondents stated that the present system was as safe or safer than the prestrike system. The responses cited (1) better cooperation from working controllers, (2) pilots becoming more aware of their responsibilities, (3) better ARTCC-terminal coordination, and (4) the increase in safety caused by fewer aircraft and increased separation standards.

The negative statements from the respondents generally concerned delays for general aviation pilots, and the inability of some general aviation flights to get into the system. Several comments concerned poor Flight Service Station (FSS) service. These complaints concerned the nonavailability of the FSS by telephone, poor weather and Notice to Airman (NOTAM) briefings (especially about closed towers (see appendix H) or towers with reduced hours), and a general lack of response to general aviation needs. Many respondents believed that the closed and reduced-hour towers were a safety problem. Additionally, some believed that many pilots did not know how to operate from an uncontrolled airfield. Two respondents complained about student pilots receiving priority to conduct practice instrument approaches, while several others believed that too much controller capacity was devoted to VFR flight-following and to services to VFR aircraft transiting terminal radar separation areas. Finally, there were complaints about air taxi operators receiving priority over general aviation flights.

Only one hazardous condition was reported to the Safety Board by the respondents. A representative of an air carrier reported that different frequencies were being used at some airports where the towers were closed or were operating at reduced hours. He stated that pilots used UNICOM, FSS, and tower frequencies and considerable confusion had resulted at some airports.

The FAA issued General Notice to Airmen (GENOT) 1/183 on this subject on September 8, 1981. It stated:

> At airports where the tower is temporarily closed and there is no FSS, until the tower reopens or is decommissioned, the tower frequency should be used for self announce traffic purposes (ref AIM 157C(2)). For procedures purposes these towers should be considered the same as part time tower closed. FSS's having temporarily closed towers in their area of responsibility shall contact fixed based operators to ensure that they are aware of these procedures. Pilots planning to operate from such airports should be briefed on the use of the tower frequency for self announce traffic purposes.

An additional GENOT (1/184) was issued on this subject which stated:

> Notice N7110.770 Subject/Guidance concerning IFR aircraft landing at airports not serviced by a tower or FSS.

Part 1 of 1 - In view of the number of towers that have been closed or which have reduced their hours of operation, this notice is to emphasize the procedure in H7110.65B-390.

This also accentuates the need for pilots to adhere to the procedures in AIM-154, AIM-157 and AC 90-42B, which may be explained as part of pilot briefings, personal contacts, and other pilot awareness efforts. Conversely, it is important that when a controller is handling an aircraft operating on an IFR flight plan intending to land at an airport not served by a tower or FSS, the pilot be changed to the advisory frequency as soon as direct communication is no longer required.

Several FSS's were contacted to determine what information was being given to general aviation pilots. The Indianapolis FSS was called and asked for the proper frequency for the airport at Muncie, Indiana. An FSS specialist was not sure and gave the FSS, tower, and VFR advisory frequencies. An FSS specialist at Zanesville, Ohio, suggested that the tower frequency was correct, but he was not positive. Three FSS specialists at the Washington, D.C., FSS were not aware of the frequency for the airport at Buffalo, N.Y., for use after the tower closed. They suggested three frequencies. A San Antonio, Texas, FSS specialist was unaware of the correct frequency for the Laredo, Texas, airport, but suggested UNICOM or tower.

This small survey indicated that there were some ATC system users and FSS specialists who were not aware of the proper procedures for the 320 airports at which towers were closed or hours of operation reduced because of the ATC curtailment. The Safety Board recognizes that the standard GENOT's and NOTAM's have been issued. However, experience has shown that many pilots do not see NOTAM's. As a result, the FSS specialist becomes the primary vehicle for transmitting new information to general aviation pilots. The Safety Board believes that additional measures are indicated to assure that FSS specialists know the correct procedures for operations at airports with closed towers so that the information can be relayed to all pilots.

CONCLUSIONS

1. The ATC system was operated safely in the 2 months following the strike.

2. The capability of the system to be operated safely in future years depends on the proper management of the total traffic capacity of the system in relation to the individual controller's capacity to handle traffic and the quality of the controller training program.

3. The FAA's initial strike planning resulted in the development of a National Air Traffic Control Contingency Plan to regulate the amount of air traffic based on assumed controller walkout being on the order of 85 percent.

4. The full contingency plan was never implemented because the FAA determined that enough controllers would remain at work to institute the Air Traffic Control Interim Operations Plan.

5. Between 32 and 35 percent of the controller workforce were not terminated, although some facilities lost 100 percent of their full performance level controllers.

6. The combination of the use of qualified ATC supervisors and staff personnel to fill in at control positions and nonstriking controllers has allowed the FAA to operate the ATC system at 75 to 80 percent of the prestrike capacity.

7. No basic ATC procedures have been changed or compromised in the poststrike ATC system.

8. There were a higher number of reported operational errors and near midair collisions during the first 2 weeks of the strike than in late August and September.

9. FAA operational errors decreased from 1.83 per day in August and September 1980 to 0.77 operational errors per day in August and September 1981.

10. There was no indication that working controllers had failed to report operational errors or operational deviations, although the numbers of reports they filed was significantly below historic levels for the August - September period.

11. Many facilities equaled or exceeded prestrike traffic levels in August and September despite severely reduced controller workforce levels.

12. Flow control procedures have smoothed most of the peaks and valleys in traffic flows.

13. Flow control procedures have been satisfactory with regard to aircraft within the IFR structure; however, ATC system capacity planning needs to take into better account the needs and effects of VFR traffic.

14. Most ATC facility supervisors believe general aviation traffic may have to be limited to 60 to 80 percent of prestrike levels for 1 to 3 years.

15. The number of unscheduled computer interruptions was reduced significantly at almost every facility after the strike.

16. Industry users of the ATC system were satisfied with the safety and general operation of the system.

17. Flight Service Station specialists were not completely knowledgeable of GENOT's issued on traffic procedures at airports whose towers have been recently closed or at towers at which hours of operation have been reduced.

18. The foundation of adequate ATC system capacity is the capacity and proficiency of the individual controller.

19. The curriculum and academic standards of performance at the FAA training center have not changed from prestrike requirements.

20. A Safety Board review of the program of instruction to full performance level controller status of replacement controllers indicates the program can be completed in 2 1/2 to 3 years.

21. A developmental controller qualified on at least two sectors can perform ATC duties safely at the sectors where the person is qualified.

22. The number of training personnel available to conduct training is limited at most facilities.

23. The major training problems are the availability of both training personnel and qualified controllers to conduct on-the-job training.

24. The over-the-shoulder training evaluation is not productive and should be replaced by a more meaningful evaluation system.

25. The FAA projection that the controller workforce will reach 12,500 controllers in January 1984 is optimistic by at least 6 to 8 months.

26. The controller workforce may not reach a prestrike ratio of full performance level controllers to developmental controllers until about 1985.

27. Many staff and supervisory controllers were recertified in late July and early August.

28. The recertification of staff and supervisory controllers was accomplished in full accord with the criteria that existed before the strike.

29. Many controllers and supervisors stated that some of the recertified controllers were not fully proficient for the first 2 weeks of the strike.

30. Military controllers and newly hired employees were used initially in noncontrol positions in order to spare operational controllers to work control positions.

31. Every allegation of medically unfit or unqualified persons working as active controllers that was investigated was unfounded in each case.

32. First-line facility supervision was frustrated before the strike by a combination of a lack of middle management and upper-echelon FAA support and union problems.

33. The present ATC system can be operated safely and efficiently with a reduced controller workforce because of flow control procedures, an increased work week, more time spent per day per controller in active control of aircraft, the combining of sectors and control positions, and a reduction in sick and annual leave.

34. FAA headquarters and regional management did not support facility management before the strike.

35. Management changes must be made in the FAA administration of the ATC system if the problems which existed before the strike are to be resolved.

36. Poststrike facility supervision is weak in many facilities because supervisory personnel must be used in operational positions.

37. Stress and fatigue had not emerged as major problems in the general controller workforce in August and September, but these factors could become problems in the future.

38. A major problem of working controllers is related to potential stress and fatigue problems including apprehension caused by harassment by striking controllers.

39. Many controllers who were scheduled to work 48 hours per week also worked some additional overtime during August and September 1981. Some controllers have worked back-to-back 10-hour days.

40. The FAA has no formal program to monitor stress and fatigue nor does it consider stress a major problem.

RECOMMENDATIONS

During this investigation, the National Transportation Safety Board issued the following safety recommendations to the Federal Aviation Administration on October 14, 1981:

> Establish and implement a program to detect the onset of, and to alleviate, controller fatigue and stress. (Class II, Priority Action) (A-81-145)
>
> In addition to recent efforts to reduce scheduled IFR traffic now operating under national flow controls, implement additional controls both at the national and facility levels which will reduce controller and facility workloads by limiting nonscheduled IFR operations and air traffic control and discretionary services being provided to VFR operations. (Class I, Urgent Action) (A-81-146)
>
> Require that, at any time that a first-line supervisor is to work a control position in addition to performing supervisory duties, a procedure is in place at the facility through which qualified personnel are immediately available for assistance or coordination. (Class II, Priority Action) (A-81-147)

In addition, the Safety Board recommends that the Federal Aviation Administration:

> Establish a program to periodically reemphasize use of the National Aeronautics and Space Administration's Aviation Safety Reporting System (ASRS) by controllers to report hazardous conditions. (Class III, Longer-Term Action) (A-81-154)
>
> Adopt procedures and directives to use the student evaluations prepared by training personnel at the FAA controller training center as a placement tool for new controllers. (Class III, Longer-Term Action) (A-81-155)
>
> Establish a periodic formal evaluation process to monitor the standardization of ATC practices and proficiency of controllers utilizing a facility's staff specialists as well as first-line supervisors. (Class II, Priority Action) (A-81-156)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PATRICIA A. GOLDMAN
Member

/s/ G. H. PATRICK BURSLEY
Member

December 8, 1981

APPENDIXES

APPENDIX A

FACILITY CLASSIFICATION LEVELS

ATC facilities are classed by level of complexity and traffic volume/density.

Measure of traffic density for the various levels of terminals and centers is expressed in terms of the average hourly operations handled between 0700 and 2300 local time for each terminal's 183 busiest traffic days of the year.

Facility Type	Aircraft per hour density	Facility level	Controller grade
Terminal			
Non-approach control (VFR tower)	up to 34	I	GS-10
Non-radar approach control (IFR tower)	up to 24	I	GS-10
Non-approach control (VFR tower)	35 to 89	II	GS-11
Non-radar approach control (IFR tower)	25 to 79	II	GS-11
Non-approach control (VFR tower)	90 or more	III	GS-12
Non-radar approach control (IFR tower)	80 or more	III	GS-12
Limited radar terminal (BRITE tower)	25 to 59	III	GS-12
Radar approach control	20 to 59	III	GS-12
Limited radar terminal (BRITE tower)	60 or more	IV	GS-13
Radar approach control	60 to 99	IV	GS-13
Radar approach control	100 or more	V	GS-14
En route			
Center	up to 169	I	GS-12
Center	170 to 274	II	GS-13
Center	275 or more	III	GS-14

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APPENDIX B

GLOSSARY

Trainee: Entry at the GS-5 level.

Developmental: GS-7 through GS-13 depending on complexity level of facility.

FPL: Full performance level or journeyman controller. GS-10 through GS-14 depending on complexity level of facility.

DSS (DSO): Data Systems Specialist, assigned grade of FPL controller at facility. Must possess current medical clearance. Shall maintain the same currency and proficiency as first-line supervisor.

PPS: Planning and Procedures Specialist, assigned grade of FPL controller at facility. Must possess current medical clearance. Shall maintain the same currency and proficiency as first-line supervisor.

EPDS (EPDO): Evaluation and Proficiency Development Specialist, assigned grade of FPL controller at facility. Must possess current medical clearance upon entry in EPDS position but may remain as EPDS if medical clearance is revoked. Shall maintain the same currency and proficiency as first-line supervisor if medically qualified.

TS: Team Supervisor, assigned one (1) grade level higher than FPL controller at facility. Must possess current medical clearance. Shall, as a minimum, maintain currency and proficiency on at least one radar or non-radar position, as appropriate, and one tower cad, as applicable.

Full Performance Level Controller

A full performance level (FLP) controller is a controller at an ARTCC who is qualified at all the sectors in an area of specialization. The equivalent of an FPL controller in a terminal is a facility-rated controller.

Developmental Controller

A developmental controller is not qualified on all sectors with an area of specialization at an ARTCC or at all control positions in a terminal facility. However, a developmental controller may be certified and proficient at some or most of the sectors or positions.

Air Traffic Representative

Air Traffic Control Specialist (ATCS) assigned as Air Traffic liaison to military flying functions at USA/USN/USAF/USMC/USCG flying facilities or at military headquarters level units.

Operations Officer/Operations Specialist

Officer responsible for operational procedures for facility. Specialists work under officer.

Area Specialist

Same as operations specialist.

"A" Side Controller

Assistant controller in an ARTCC who does not control air traffic; provides assistance to operational controllers.

Military Liaison & Security Specialist

Handles coordination for military requests for special military operations; manages all classified materials in facility

Annuitant

A retired employee who returns to work for a government agency and who receives in salary his retirement pay plus the difference between the retirement pay and that of a full-salaried employee.

Terminal Area

A general term used to describe airspace in which approach control service or airport traffic control service is provided.

VFR Tower

A facility established to provide VFR air traffic control services to airport traffic.

Radar Facility

A terminal ATC facility that uses radar or non-radar capabilities to provide approach control services to aircraft arriving, departing, or transiting airspace controlled by the facility.

Air Route Traffic Control Center (ARTCC)

A facility established to provide ATC services to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight. Sometimes referred to as "Center" only.

Sector

A portion of airspace within an ARTCC or terminal radar facility.

Control Position

Term used to describe any position of operation that engages in active air traffic control.

Area of Specialization

A term used in ARTCC; a group of interrelated sectors on which an ATCS is required to maintain currency.

Flow Control/Flow Controller

Measures designed to adjust the flow of air traffic into a given airspace, along a given route or into a given airport so as to ensure an orderly flow of aircraft with minimal delay.

Mode "C" Transponder

The airborne radar beacon receiver/transmitter reply that is visually displayed in 100-foot increments on a radarscope. An additional piece of equipment on the aircraft that transmits the actual altitude of the aircraft.

GENOT (General Notice to Airmen)

FAA term meaning a general notice that transmits information to controllers.

NOTAM (NOTICE TO AIRMAN)

A notice containing information concerning establishment, condition, or change in any facility, service, procedure, or hazard in the National Airspace System (NAS).

Flight Service Station (FSS)

FAA-operated facilities which provide pilot weather briefs, VFR en route communications, VFR search and rescue services, assist lost aircraft, relay ATC clearances, receive and process IFR flight plans, take weather observations, issue airport advisories, monitor NAVAIDS, etc.

APPENDIX C

CONTROLLER RETIREMENT PROJECTIONS

	Terminal		ARTCC	
	Early retirement 1/	Optional 2/	Early retirement	Optional
1981	879	103	759	66
1982	381	15	344	23
1983	248	24	316	29
1984	326	28	319	26
1985	245	70	134	76

1/ Includes controllers with 25 years controller service and controllers with 20 years service and age 50.
2/ Standard retirement qualification of 30 years service and age 55, or some combination thereof.

APPENDIX D

FACILITIES SURVEYRD DURING FIELD INVESTIGATION

Air Route Traffic Control Centers

Los Angeles
Oakland
Seattle
Chicago
Denver
Cleveland
Boston
Indianapolis
Atlanta
Miami
Jacksonville
New York
Washington
Fort Worth

Terminal facilities (towers and radar)

Los Angeles International Airport
Oakland International Airport
Seattle - Tacoma International Airport
Dulles International Airport
Chicago O'Hare International Airport
St. Louis (Lambert Field)
Hartsfield Airport, Atlanta
Miami International Airport
Jacksonville International Airport
Washington National Airport
Indianapolis International Airport
John F. Kennedy International Airport
La Guardia Airport
Cleveland Hopkins International Airport
Milwaukee - General Mitchell Field
Dallas-Fort Worth Regional Airport
Fort Wayne Airport
Norfolk International Airport
Van Nuys Airport
John Wayne/Orange County Airport
Daugherty Field, Long Beach
Lindbergh Field, San Diego
Du Page Airport
Pal - Waukee Airport
Arapahoe County Airport
Opa Locha Airport
Fulton County, Georgia Airport
Boston Logan International Airport
New York Common IFR
San Francisco International Airport
Stapleton International Airport

APPENDIX E

ATC FACILITY TRAFFIC COUNT

AIR TRAFFIC CONTROL FACILITY TRAFFIC COUNT[1/]

Facility	July 1981 Total	July 1981 Commercial[2/]	July 1981 General Aviation	July 1981 Military	August 1980 Total	August 1980 Commercial	August 1980 General Aviation	August 1980 Military	August 1981 and Percent of August 1980 Total	%	Commercial	%	General Aviation	%	Military	%
Indianapolis ARTCC	141,744	37,763	80,857	13,124	132,633	66,332	55,886	10,415	106,693	80.4	55,833	84.2	40,466	72.4	10,394	99.7
Los Angeles ARTCC[3/]	129,199				138,710	62,308	51,296	24,906	108,766	78.4	55,096	88	39,478	77	14,192	57
Cleveland ARTCC	170,769	103,841	59,806	7,102	176,800	104,568	65,776	6,456	129,784	73.4	83,734	80	41,895	63.7	4,155	64.4
Chicago ARTCC	195,227	111,011	77,572	6,644	190,318	110,998	73,562	5,758	123,241	64.7	86,759	78.1	33,246	45.2	3,236	56.2
Atlanta ARTCC	139,246	89,444	36,845	12,957	130,721	87,232	30,414	13,075	140,697	93.3	79,259	90.8	50,296	99.8	11,142	85.2
Oakland ARTCC	133,219	43,763	56,712	32,744	126,919	68,490	29,981	28,448	91,556	72.1	54,706	79.9	21,605	72.1	15,245	54.6
Seattle ARTCC[3/]	101,826	IFR 81,863	VFR 19,963		108,285	IFR 87,285	VFR 21,000		84,689	78.2	IFR 67,104	76.9	VFR 17,585	83.7		
Jacksonville ARTCC[3/]	N/O				116,541	52,476	31,765	32,300	114,923	98.3	47,141	89.8	35,054	110.4	32,728	101.3
Miami ARTCC	124,631	80,419	29,852	14,160	116,692	78,016	28,279	10,397	114,374	98	76,234	97.7	27,707	97.9	10,433	100.3
Houston ARTCC[3/]	N/O				102,398	56,043	31,387	14,968	73,780	70	43,376	77	18,101	58	10,303	69
New York ARTCC	160,437	101,834	44,113	14,690	159,339	100,743	46,417	12,179	121,301	76.1	83,605	82.9	25,759	55.5	11,937	98
Washington ARTCC	152,647	82,127	47,630	22,880	141,636	78,525	41,002	22,109	124,024	87.5	69,366	88.3	35,121	86.1	18,537	83.8
Denver ARTCC	97,223	60,330	25,562	11,331	90,394	57,991	21,218	11,185	74,171	82	47,047	81.1	19,489	91.9	7,635	68.3

Facility	July 1981 Total	July 1981 Commercial	July 1981 General Aviation	July 1981 Military	August 1980 Total	August 1980 Commercial	August 1980 General Aviation	August 1980 Military	August 1981 and Percent August 1980 Total	%	Commercial	%	General Aviation	%	Military	%
Fort Worth ARTCC[2]	175,218	IFR 169,330	VFR 5,888		153,499	IFR 146,471	VFR 7,028		131,094	74	IFR 128,687	87.8	VFR 2,407	34.2		
St. Louis (Lambert Field)	25,879	21,385	4,141	353	26,365	22,197	3,792	356	19,648	73	16,603	74	2,805	74	366	102
Dallas-Fort Worth Regional Airport	46,379	43,821	2,519	39	40,434	36,207	2,195	52	37,618	92.9	35,306	96.6	2,170	98.8	62	119
Pal-Waukee Airport	Itinerant 19,569	219	7,923	113	Itinerant 23,924	74	12,866	8	17,191	71	Itinerant 383		10,141	78	3	37
	Local Civil and Military 11,303			10	Local Civil and Military 10,972			4	Local Civil and Military	–			6,664		0	
Hartsfield Int'l - Atlanta[3]	N/O				51,228	45,396	2,694	138	44,853	87.6	42,104	86.9	2,447	91.6	282	204.3
Logan Int'l - Boston	30,741	26,983	3,681	77	29,621	25,967	3,540	114	24,767	83.6	21,427	82.5	3,290	91.6	60	52.6
Oakland TRACON	59,981	27,671	29,296	3,014	59,032	32,727	23,944	2,361	44,239	74.9	28,110	85.6	14,993	66.2	2,145	90.8
O'Hare Int'l - Chicago	63,406	58,213	4,813	380	61,983	57,434	4,221	328	45,341	72.9	42,212	73.5	2,845	67.4	284	86.6
Jacksonville Airport[3]	N/O				6,355	3,265	2,278	812	6,285	98.9	3,270	100.2	2,200	96.6	815	100.4
San Francisco Int'l	27,635	24,606	2,837	192	September 1981 25,331	20,005	5,133	193	July 1980 vs August 1981 24,626	89.1	21,625	88.1	2,754	97.7	123	64.1
Indianapolis Int'l	25,873	9,561	15,443	869	25,644	8,531	15,884	1,229	19,636	76.6	8,542	100	10,570	66.5	524	42.6
Hopkins Int'l - Cleveland	32,091	14,266	17,376	449	30,978	14,799	15,865	314	24,890	80.3	12,695	85.7	11,861	74.7	334	106
SEA - TAC Int'l	35,173	26,114	9,059		36,909	27,294	9,615		31,368	85	IFR 22,163	81.2	VFR 9,205	95.8		
Miami Int'l[3]	N/O				27,057	24,464	2,568	25	25,582	94.5	22,765	93.1	2,533	98.6	284	113.6

Facility	July 1981 Total	July 1981 Commercial	July 1981 General Aviation	July 1981 Military	August 1980 Total	August 1980 Commercial	August 1980 General Aviation	August 1980 Military	August 1981 and Percent August 1980 Total	%	Commercial	%	General Aviation	%	Military	%
															Page 3	
Du Page Airport	22,668	152	22,508	28	21,342	83	21,266	12	18,961	88	125	150	18,801	88	15	93
General Mitchell Airport Milwaukee	21,871				28,499				15,458	54						
Arapahoe County Airport Denver	40,013	375	40,317	71	36,189	252	35,916	21	32,766	90.5	232	92	32,307	90.5	27	128.5
Stapleton Int'l - Denver	45,398	36,038	9,246	112	43,013	32,943	9,823	247	39,217	91.2	31,317	95.1	7,644	77.8	246	99.6
John Wayne/Orange Airport (Santa Ana, CA)	55,520	4,918	50,486	116	48,833	2,512	46,138	183	44,036	90.2	4,930	196.3	39,014	84.6	92	50.3
San Diego Int'l TRACON Lindbergh Field	44,877	IFR 44,877	VFR N/A		40,827	IFR 40,827	VFR N/A		36,556	89.5	IFR 36,556	89.5				
Van Nuys Airport	55,728	0	55,035	693	56,756	2	56,424	330	58,806	103.6	0	0	58,277	103.3	529	160.3
Los Angeles Int'l TRACON	49,400	32,021	17,022	397	50,871	35,432	15,155	284	43,123	84.8	29,645	83.7	13,134	86.7	344	121
Daugherty Field Long Beach, CA	55,520	4,918	50,486	116	48,833	2,512	46,138	183	44,036	90.1	4,930	196.3	39,014	84.6	92	50.3
Ft. Wayne Airport	10,511	2,318	7,355	838	12,023	2,122	8,728	1,173	8,301	69	2,174	102.4	5,718	65.5	409	34.9
Fulton County Airport2/ Atlanta, Georgia	N/O				19,900	348	19,123	429	16,307	81.9	640	183.9	15,161	79.3	506	117.9
Los Angeles Int'l Tower	47,597	35,476	11,796	325	47,520	37,973	9,373	224	39,219	82.5	32,684	86.2	6,473	69.1	62	27.7

Facility	July 1981 Total	July 1981 Commercial	July 1981 General Aviation	July 1981 Military	August 1980 Total	August 1980 Commercial	August 1980 General Aviation	August 1980 Military	August 1981 and Percent August 1980 Total	%	Commercial	%	General Aviation	%	Military	%
Norfolk TRACON and Tower 2/ 4/	N/O				29,073	7,645	12,850	8,578	22,374	77	4,866	63.6	9,037	70.3	8,481	98.9
Dallas TRACON and Tower 4/	24,327	5,229	17,171	1,927	22,217				July 1981 to August 1981 19,343	87.1	4,953	94.7	13,179	76.6	1,240	64.3
J. F. Kennedy Int'l	24,293 Total Operations - 45,748	22,826	1,421	46	25,136 Total Operations - 29,962	23,912	1,154	62	21,406	85.2	20,628 Total Operations - 27,168	86.3	753	65.3	25	40.3
La Guardia Airport	28,355 Total Operations - 45,748	24,364	3,426	65	25,714 Total Operations - 37,720	21,828	3,837	49	19,825	77.1	18,644 Total Operations - 23,050	75	1,150	32.7	31	47.7
New York TRACON	86,749 Total Operations 101,512; Stage III - 14,721	65,504	20,879	366	N/O				66,717	65.2	54,7?. Total Operations - 64,210; Stage III - 3,486	83.6	11,229	53.5	234	63.9

1/ Traffic counts provided by individual facilities

2/ Includes air carrier and air taxi traffic counts

3/ Breakdown or figures not obtained

4/ Includes airport, satellites, overflights, and Stage III counts

NOTE: Satellite airport traffic is not reflected in any facility count except as noted

APPENDIX F

CURRENCY REQUIREMENTS FOR CONTROLLERS

Chapter 6. CURRENCY REQUIREMENTS

Section 1. GENERAL

→ **150. BASIC REQUIREMENTS**

It shall be the responsibility of the employees identified below to adhere to the following basic requirements:

a. Facility Chiefs, Deputy Chiefs, Facility Officers, and Assistant Chiefs shall observe at least one control position in their facility for a minimum of two (2) hours each week.

b. First-line Supervisors shall, as a minimum, maintain currency and proficiency on at least one radar sector within their areas of specialization

c. Flow Controller, Staff Specialists and Data Systems Specialists Requirements:

(1) Flow controllers and temporarily assigned staff specialists shall maintain the same currency and proficiency requirements as first-line supervisors.

(2) Permanent staff specialists, other than DSSs, shall either maintain the same currency and proficiency requirements as first-line supervisors or observe at least one control position in their facility for at least two (2) hours each week. The exact number and types of positions shall be determined by the Facility Chief.

(3) Data Systems Specialists shall either maintain the same currency and proficiency requirements as first-line supervisors or observe a control position in their facility for a period of at least four (4) hours each week. The exact number and types of positions shall be determined by the Facility Chief.

d. Specialists (FPL/Developmentals) Requirements:

Specialists (FPL) shall remain current and proficient in all functions and responsibilities associated with their grade or position. This requirement shall not necessarily be imposed upon developmental specialist who, while attempting to qualify for higher grade-level duties, are unable to remain current in functions and responsibilities otherwise associated with their present grade.

e. Only current and proficient air traffic personnel shall be assigned responsibilities of operating a control position/sector.

f. Within appropriate time limits, the specialist, supervisor, flow controller, and temporarily assigned staff specialist shall demonstrate their ability to apply relevant procedures and techniques. No less than 50 percent of this requirement shall be met using actual traffic conditions. The remainder may be conducted under simulated conditions.

APPENDIX G

FACILITY CONTROLLER AND CONTROLLER STAFF SITUATIONS

FACILITY CONTROLLER AND CONTROLLER STAFF SITUATIONS
(Available Control Staff) 1/

	TERMINALS 2/										
	July 31			August 28				September 30			
Facility	FPL	DEV	Staff	FPL	DEV	Staff	% Left	FPL	DEV	Staff	% Left
Kansas City Intl	49	5	4	9	12	5	45	10	15	5	52
St. Louis	51	8	5	18	2	5	39	18	2	5	39
JFK	24	9	1	2	3	0	15	1	4	0	15
La Guardia	26	10	1	4	2	0	17	2	3	0	14
Baltimore	44	15	5	16	6	4	41	18	4	5	42
Norfolk	48	15	3	14	4	6	36	14	5	5	36
Philadelphia	58	20	6	21	3	7	37	23	1	7	37
Washington Intl	70	5	7	15	2	6	28	10	4	6	24
Pittsburgh	71	5	4	9	0	6	19	11	3	5	23
NY TRACON	121	53	22	12	9	26	23	18	12	22	26
Cleveland	49	11	4	8	5	4	27	12	5	2	30
Columbus	51	1	4	25	0	0	45	25	0	1	46
Dayton	35	19	2	11	2	0	23	11	3	0	25
Indianapolis	52	4	4	10	2	7	32	10	3	3	27
Milwaukee	37	10	4	11	1	5	33	10	1	2	25
O'Hare	77	22	8	17	22	23	58	18	39	8	63
Detroit	63	5	6	21	0	2	31	20	2	3	34
Bradley	49	0	3	13	0	2	29	14	0	3	33
Logan Intl	54	11	6	11	0	10	26	14	0	6	25
Seattle-Tacoma	49	0	4	21	5	5	58	22	6	5	62
Portland	44	1	4	9	3	6	37	10	7	3	41
Honolulu	43	4	3	7	0	2	18	5	2	1	16
Salt Lake	51	2	4	19	0	2	37	19	1	2	39
Denver	61	1	7	16	2	10	41	24	4	3	45
Charlotte	44	1	4	19	0	5	49	19	0	5	49
Jacksonville	52	0	5	10	0	5	26	10	0	5	26
Memphis	61	0	5	6	0	3	14	2	0	5	11
Orlando	46	0	3	20	0	4	49	20	0	3	47
Pensacola	63	0	2	21	0	2	35	20	0	2	34
Tampa	64	0	6	19	0	5	34	21	0	5	37
West Palm Beach	44	1	1	14	1	2	37	12	2	2	35
Hartfield Intl	99	1	10	34	7	7	44	35	8	7	45
Miami Intl	80	7	6	12	1	8	23	12	3	6	23
Lubbock	40	1	3	25	0	3	64	25	0	3	64
New Orleans	41	1	2	13	1	2	36	13	0	2	34
San Antonio	59	0	5	11	1	6	28	13	4	5	34
Oklahoma City	46	0	4	20	2	4	52	20	2	4	52
Dallas-Ft. Worth	93	0	7	41	12	14	67	42	18	6	66
Houston	67	8	5	25	13	13	64	25	23	4	65
Ontario	35	4	4	9	3	9	49	10	11	3	56
Las Vegas	47	0	5	7	11	5	44	7	10	5	42
Edwards AFB	32	2	5	13	0	2	38	13	0	2	38
El Toro MAS	47	3	4	10	3	5	33	10	7	1	33
Los Angeles	47	2	7	1	7	14	43	4	15	6	45
Phoenix	51	0	4	16	3	8	49	20	5	1	47
Oakland	65	0	5	16	8	9	47	15	17	2	49
San Diego	49	2	4	28	1	5	61	29	3	2	61
McClelland AFB	46	0	4	17	2	5	48	16	4	4	48

1/ Staff includes Plans Procedure Specialists, Data System Specialists, Military Liaison Specialists, Flow Controllers.

2/ Level IV and V only

APPENDIX G

FACILITY CONTROLLER AND CONTROLLER STAFF SITUATIONS
(Available Control Staff)

AIR ROUTE TRAFFIC CONTROL CENTER

Facility	July 31 FPL	July 31 DEV	July 31 Staff[1/]	August 28 FPL	August 28 DEV	August 28 Staff[1/]	August 28 % Left	September 30 FPL	September 30 DEV	September 30 Staff[1/]	September 30 % Left
Anchorage	75	45	16	15	24	26	48	18	36	14	50
Kansas City	272	95	39	126	44	43	52	138	45	31	53
New York	343	173	44	53	25	52	23	99	56	15	30
Washington	345	104	44	201	77	50	67	217	71	46	63
Cleveland	420	123	40	120	32	38	33	146	48	21	37
Minneapolis	230	95	41	42	24	46	31	48	60	38	40
Chicago	333	167	41	44	54	45	26	45	79	31	29
Indianapolis	281	131	35	48	30	57	30	75	45	19	31
Boston	273	47	38	57	38	54	42	70	55	24	42
Seattle	181	51	22	89	36	11	54	87	36	12	53
Honolulu	73	14	14	24	2	4	30	27	12	4	63
Salt Lake	130	74	26	67	29	33	56	83	32	14	56
Denver	226	63	48	73	45	48	49	66	49	49	49
Atlanta	334	58	58	141	22	47	47	145	55	34	55
Jacksonville	278	38	34	146	13	32	55	165	33	13	60
Memphis	257	97	32	88	31	40	41	91	51	32	45
Miami	194	101	30	61	24	34	37	67	35	31	41
Albuquerque	214	85	26	121	74	30	69	134	67	22	69
Fort Worth	316	100	26	130	43	49	50	141	62	25	52
Houston	281	81	34	121	36	50	52	125	75	32	59
Los Angeles	217	122	36	86	41	48	47	109	71	23	54
Oakland	191	89	35	99	15	32	46	102	29	19	48

1/ Staff - includes PPC, DSS, MLSS, Areas Specialists, F/C

APPENDIX H

AIRPORT TOWERS CLOSED BECAUSE OF CONTROLLERS STRIKE

Martha's Vineyard, MA
New Bedford, MA
Lawrence, MA
Danbury, CT
Worcester, MA
Beverly, MA
Groton, CT
Marysville, CA
Riverside, CA
North Las Vegas, NV
Imperial, CA
Laredo, TX
McAllen, TX
Ponce, PR
Mayaguez, PR
New Bern, NC
North Myrtle Beach, SC
Brunswick, GA
Molokai, HI
Dade-Collier (Miami),FL
West Memphis, AR
Hot Springs, AR
Shreveport (Downtown), LA
Merced, CA
Alexandria, LA
Ardmore, OK
Olympia, WA
Pendleton, OR
Plainview, TX
Enid, OK
Grand Island, NE
Lebanon, NH
San Diego (Brown), CA
Cape Girardeau, MO
Joplin, MO
Topeka (Billard), KS
Lewisburg, WV
Danville, IL
Akron (Muni), OH
Benton Harbor, MI
Valdosta, GA
Athens, GA
Tuscaloosa, AL
Hickory, NC
Salina, KS
Fresno (Chandler), GA
Flagstaff, AZ
Salinas, CA (plan to reopen 10/19/81)
Lancaster, CA
Knoxville (Downtown), TN
Jackson (Hawkins), MS
Spartanburg, SC
Hobbs, NM
Pine Bluff, AR
Santa Fe, NM
Marion, IL
San Antonio (Stinson), TX
Galesburg, IL
Greenville, MS
Paducah, KY
Bloomington, IN
Muncie, IN
Santa Maria, CA
Chico, CA
St. Petersburg (Albert Whitted), FL
Kinston, NC
Farmington, NM
Ann Arbor, MI
Owensboro, KY
Cleveland (Cuyahoga), OH

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